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Volume XXXVI MARCH, 1943 No. 1

THE HOMOLOGIES OF THE RING GLAND OF DIPTERA BRACHYCERA

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A prerequisite of any theory of the source of insect hormones which attempts to reconcile observations on the Diptera with those on other insects is a knowledge of the homologies of the ring gland. This organ was first described by Weismann in 1864 in his description of the development of *Calliphora vomitoria* L. and *Sarcophaga carnaria* Meig., and has been referred to frequently as "Weismann's Ring." It has since been described many times in various Diptera Brachycera, usually having been considered, following Weismann, a supporting structure of the dorsal vessel. Burtt, first (1937) from phylogenetic studies of Nematocera and Brachycera and from the morphology of the gland, and later from a physiological investigation (1938) concluded that the ring gland is homologous with the corpus allatum of other insects. Mellanby (1938) accepted this view without question. In 1938 Scharrer and Hadorn suggested that the corpus cardiacum was also included in the ring gland. Hanström (1939), without knowledge of their work, concluded that the ring gland was composed only of corpus cardiacum tissue.

The homologies of the ring gland may be elucidated by several methods: by the study of evidence from comparative morphology and phylogeny; by a determination of the embryonic origin of the constituents of the gland; or from the changes undergone by the gland at metamorphosis. The first method was utilized in reaching the conclusions mentioned above. The third method should indicate definitely the composition of the ring, for there is a typical median corpus allatum present in the adult fly. Such observations are presented in this paper.

MATERIALS AND METHODS

Most of the observations to be reported were made on the larvae, pupae, and adults of a pure strain of *Lucilia sericata* Meig.,[1] which

[1]Obtained through the courtesy of Dr. D. F. Miller, Ohio State University, to whom my thanks are due. For a description of this strain, see Miller (1940), Science, 92: 147–148.

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was maintained in culture at a temperature of 21 ± 1° C. The various stages were fixed by injection with Bouin's fluid or formol-sublimate in 0.4% NaCl, followed by Mallory's triple stain, or by the Duboscq-Brasil modification of Bouin's fluid followed by Bodian's protargol technique. Tissues were double embedded in celloidin and paraffin and sectioned at 7 or 10 microns.

DEVELOPMENT AND MORPHOLOGY OF THE RING GLAND

The ring gland of the full-grown larva will first be described, then its condition in pupae of various ages, and finally the glands of the mature fly.

I. The Full-grown Larva.—The ring gland of *Lucilia* has not been previously described, but does not differ in essentials from that of *Calliphora* (Burtt, 1937). It is, however, considerably more elongate (fig. 1). The ring is continuous above the aorta anteriorly, and beneath this vessel posteriorly due to its attachment to the hypocerebral ganglion. Nerves arising from the brain just behind the commissure enter the gland at the posterior end. It has not been possible to trace their path through the brain itself, but they probably represent the nervus corporis cardiaci I (NCC I) of Hanström (1940), with nerve cell bodies in the pars intercerebralis. The ring gland also receives nerve fibers from the hypocerebral ganglion, which is situated on the recurrent nerve. Nerve cell bodies, conspicuous by their dense, basophilic cytoplasm, are found scattered throughout the gland, as shown by Burtt in *Calliphora*. Nerve fibers may be demonstrated between the gland cells and form a small nerve which runs in the dorsal wall of the incomplete aorta as the latter continues anteriorly from the ring gland.

One of the reasons given by Scharrer and Hadorn for believing that some of the ring gland cells represent corpus cardiacum tissue is the close relationship between this gland and the aorta, a condition characteristic of the corpus cardiacum of many insects. In *Lucilia* the gland is distinctly separated from the aorta except at its dorsal and ventral extremities, and only at the former (fig. 4) is there any sign of "Durchlasszellen" comparable to those described by Pflugfelder (1937) in *Dixippus*. A similar condition has been found in sections of *Drosophila melanogaster* Meig. The aorta in higher Diptera is unusual in running dorsal to the brain, rather than following the gut or terminating behind the brain, as in other insects.

The tracheal supply of the gland is very characteristic (fig. 1A). A pair of large trunks enter from the anterior end of the gland on each side of the aorta, and at the point of entry, these are joined by a connecting trunk which runs entirely within the tissues of the gland. The lateral trunks continue back through the gland, and emerge from it at its posterior end just behind the NCC I. The trunks then enter the brain, and shortly break up into very many tracheoles which run to almost all parts of the supra- and sub-oesophageal ganglia. The epithelium of the trunks is unusual, being far thicker than that of most larval tracheae. The cells composing it are very small and are frequently found in mitosis, indicating that they are imaginal bud cells, as

was shown by Burtt in *Calliphora*. Whether the unusual epithelium plays any part in the physiology of the trachea would be difficult to determine.

Histologically the gland is composed of five cell types, though only two of these undergo marked changes during the pupal and adult life of the fly. Giacomini (1900) has recorded small cells at each end of the gland of *Eristalis tenax* L., and Burtt (1937) noted nerve cell bodies in the gland of *Calliphora*. Scharrer and Hadorn (1938) record the presence of cells of two distinct sizes of *Drosophila*, and consider that the small cells represent the corpus cardiacum tissue. The greater portion of the gland in the larva of *Lucilia sericata*, that is, the region on each size of the aorta, is composed principally of very large cells (approximately 30 x 40 microns), with finely granular, relatively acidophilic cytoplasm. The nucleus is large (approximately 15 microns in diameter) and poor in chromatin, while the chromosomes appear to be in the "polytene" condition, characteristic of some insect gland cells. The cytoplasm of these cells shows no inclusions with the methods employed. The nerve cell bodies, scattered between the large secretory cells, have been referred to above. The small cells at the posterior end mentioned by Giacomini, are associated in *Lucilia* with nervous tissue, since the gland is closely connected with the hypocerebral ganglion, which actually forms the ventral part of the ring. Bodian preparations show nerve fibers ramifying through this tissue. The anterior, dorsal group of small cells is closely associated with the connecting tracheal trunk, but the cells comprising the organ may be distinguished from those of the imaginal bud cells by their larger size and the more regular outline of their nuclei. In a frontal section through this region there will be, therefore, nuclei of three distinct sizes. The two large types are spherical, and are approximately 12 and 9 microns in diameter respectively. The smallest nuclei are oval and measure approximately 7 x 8 microns. This is true also of *Drosophila*, where the respective nuclear sizes are 12, 6 and 5 x 6 microns. In *Lucilia* this group of small cells is median in position and not very conspicuous even in the late larva, where there are approximately ten cells, but, as will be shown below, these cells become more conspicuous in the adult fly.

II. The Prepupa.—No gross morphological differences distinguish the gland of this stage from that of the late larva, but the large ring gland cells become vacuolated, as shown by Burtt (1937) in *Calliphora*. Burtt considers this as evidence for the production of a hormone at this stage, and there is experimental evidence that a puparium-forming hormone is secreted from this region of the insect (Fraenkel, 1935, on *Calliphora;* De Bach, 1938, on *Musca;* Hadorn, 1937, Bodenstein, 1938, on *Drosophila*). It would be of interest to correlate the time of appearance of these vacuoles with the "critical period," which varies considerably in the flies mentioned. The vacuoles vary in size from one cell to another, and may occupy so much of the cell that the cytoplasm and nucleus are restricted to the periphery (fig. 5). No changes occur in the nerve cell bodies or in the other cell types, except that mitoses are found in the imaginal bud cells surrounding the tracheae and occasionally in the anterior group of small cells.

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III. The Two-hour Pupa.—Such a pupa has not yet become fully pigmented. Some of the larval musculature is still intact, but the body cavity contains mainly conspicuous fat body cells and phagocytosed material. At this stage the gland is noticeably shortened, and the anterior part has become more dorsal in position. It still retains its connection with the larval aorta dorsally. Any vacuoles which may have characterized the large gland cells of the prepupa have now disappeared, and the cells exhibit an abundant, uniform cytoplasm, which is still relatively acidophilic as in the larva. The nuclei have increased somewhat in size (up to 22 microns in diameter) and may be irregular in outline. On the basis of the histological appearance of these cells and from a comparison of them with those of other stages, it would appear that they are very actively secreting in the early pupa. In the 12-hour pupa there is little visible change in the structure of the ring gland, but after the 24-hour stage the large gland cells begin to undergo degenerative modification.

IV. The Twenty-four-hour Pupa.—During this time the larval tissues are being further broken down, and the aorta becomes separated from the ring gland, which henceforth has no direct connection with the larval aorta. Marked changes are also occurring in the tracheal system, for at this time new tracheal branches are arising from the imaginal bud cells which surround the tracheae supplying the ring gland of the larva. (Compare Poulson, 1935, on oxygen uptake by *Drosophila* pupae.) The gland has moved posteriorly away from the connecting trunk, so that the small imaginal bud cells no longer constitute part of it. Also in the 24-hour pupa the small dorsal cells have undergone mitosis to form a larger group of cells, with nuclei characterized by their uniform shape and their single, large nucleolus. Thus, between the 12-hour and the 2-day stage they undergo their most marked changes, and so differ markedly from those of the moth, *Ephestia* as described by Schrader (1938).

V. The Two-day Pupa.—By this time the gland has shortened to almost its final length, and moved posteriorly from the brain (figs. 2 and 2A). This shortening has resulted from a decrease in the size of the gland cells and their aggregation to form a more compact organ (fig. 6). At the same time the gland is rotated so that the anterior part becomes more dorsal in position. Mitoses may still be found in the dorsal group of small cells, though these have almost reached the number present in the adult. This group is now entirely surrounded by the large gland cells. Occasional lymphocytes, with large fuchsinophil droplets in their cytoplasm, are found among the large gland cells, and throughout the pupa. The nerve cell bodies of the hypocerebral

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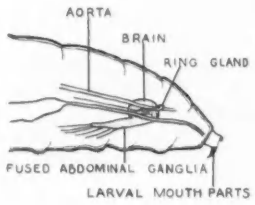
EXPLANATION OF PLATE I

Semidiagrammatic longitudinal sections of *Lucilia sericata*, showing relationships of brain, dorsal vessel, gut, and ring gland. Various magnifications.

Fig. 1. The full-grown larva. 1A. Enlarged portion of 1, showing innervation and tracheation. "X" indicates plane of Fig. 4, and "Y" the plane of Fig. 5. 2. Two-day pupa. 2A. Part of 2, enlarged. 3. Young male. 3A. Part of 3, enlarged.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BRAIN
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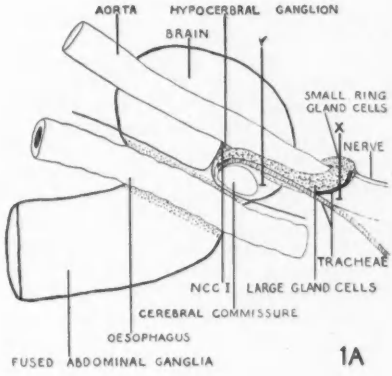
LARVAL MOUTH PARTS

1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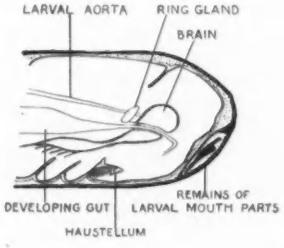
SMALL RING GLAND CELLS
NERVE
TRACHEAE
NCC I
LARGE GLAND CELLS
CEREBRAL COMMISSURE
OESOPHAGUS
FUSED ABDOMINAL GANGLIA

1A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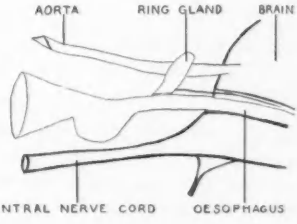
RING GLAND
BRAIN
REMAINS OF
DEVELOPING GUT
LARVAL MOUTH PARTS
HAUSTELLUM

2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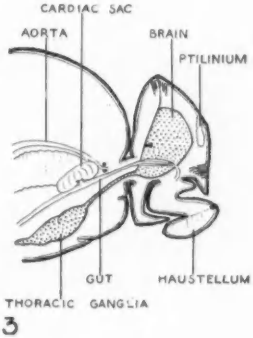
RING GLAND
BRAIN
VENTRAL NERVE CORD
OESOPHAGUS

2A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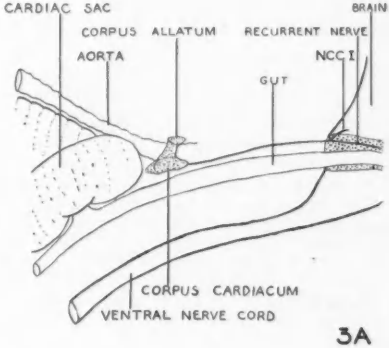

CARDIAC SAC
CORPUS ALLATUM
RECURRENT NERVE
BRAIN
AORTA
NCC I
GUT
CORPUS CARDIACUM
VENTRAL NERVE CORD

3A

ganglion are somewhat separated and lie between the developing gut and the cell of the ring. The nuclei of the large gland cells are very conspicuous, and with the decrease in the amount of cytoplasm, the cells become more basophilic.

VI. The Four-day Pupa.—By this time the flight muscles of the adult fly are well formed. The gland has moved still farther posteriorly, but since the gut has not yet produced the cardiac sac, it cannot be said to occupy the final position which it will attain in the adult. No great changes have occurred in the cells of the gland.

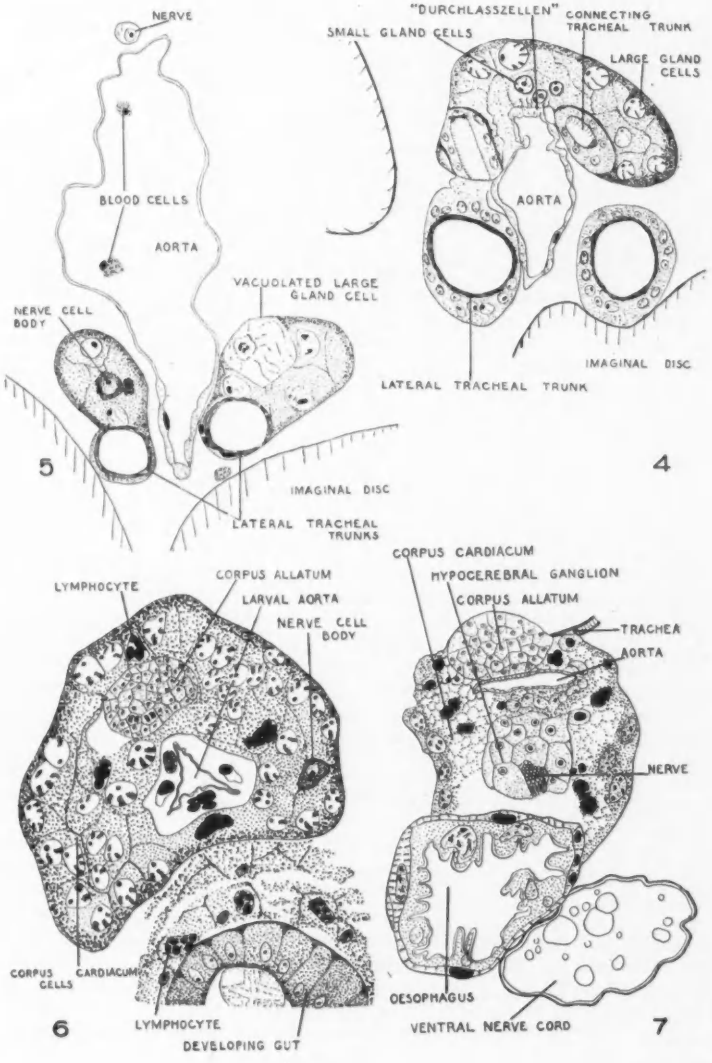
VII. The Six-day Pupa.—The gland has decreased considerably in size, due to the disappearance of much of the cytoplasm of the large gland cells. These have migrated, and may almost entirely surround the hypocerebral ganglion. The gland is now situated just anterior to the cardiac sac, and so occupies the position it does in the adult fly. The only changes seen from this condition to that in the 8-day pupa are further decreases in the amount of the cytoplasm of the large gland cells and the consequent decrease in the size of the ring.

VIII. The Adult.—At the temperature of the culture room the adult flies emerged between 9 and 11 days after puparium formation. The condition of the incretory organs in a freshly emerged male is shown in figs. 3 and 3A. The two nerves (NCC I) have increased considerably in length, and now run posteriorly from the brain, instead of anteriorly as they did in the larva. Together with the recurrent nerve (apparently arising from the frontal ganglion, though this is much reduced in the adult *Lucilia*) they unite to form a single compound nerve in the region of the cervix. The large gland cells are profusely innervated by fibers from the recurrent and from the two NCC I nerves. Nerve fibers ramify in all directions between these cells, and also between the more closely packed small gland cells. Nerve endings within these cells have not, however, been conclusively demonstrated, and a similar situation exists in the corpus allatum of the honeybee and the moth, *Ephestia*. The tracheal supply of both cell groups is from one of the thoracic air sacs, which sends a trachea to supply the cardiac sac, and from this trachea a small branch runs anteriorly to the incretory organs.

EXPLANATION OF PLATE II

Transverse sections of ring glands of *Lucilia sericata*, showing histological details. All approximately × 350, except Fig. 6, which is × 250. Drawn with the aid of a camera lucida.

Fig. 4. Anterior of ring gland of full-grown larva. Note "Durchlasszellen," small histoblast cells surrounding tracheae, medium-sized corpus allatum cells, and large corpus cardiacum cells. 5. Posterior part of the ring gland of prepupa, showing that the gland is separated from the aorta in this region. Note also the vacuole in one of the large corpus cardiacum cells, and the nerve cell body. 6. Ring gland of 2-day pupa. Note enlarged corpus cardiacum cells, the degenerating larval aorta, the lymphocytes, and the mitoses in the corpus allatum cells. The marked decrease in size of the gland between this stage and that shown in Fig. 7 is rendered less conspicuous by the differences in magnification. 7. Corpus allatum and corpora cardiaca of young adult male. Note decrease in cytoplasm of corpora cardiaca cells, the mature, compact corpus allatum cells, and the nerve cell bodies of the hypocerebral ganglion.


NERVE
BLOOD CELLS
AORTA
VACUOLATED LARGE GLAND CELL
NERVE CELL BODY
IMAGINAL DISC
LATERAL TRACHEAL TRUNKS
5
"DURCHLASSZELLEN"
CONNECTING TRACHEAL TRUNK
SMALL GLAND CELLS
LARGE GLAND CELLS
AORTA
IMAGINAL DISC
LATERAL TRACHEAL TRUNK
4
LYMPHOCYTE
CORPUS ALLATUM
LARVAL AORTA
NERVE CELL BODY
CORPUS CARDIACUM CELLS
LYMPHOCYTE
DEVELOPING GUT
6
CORPUS CARDIACUM
HYPOCEREBRAL GANGLION
CORPUS ALLATUM
TRACHEA
AORTA
NERVE
OESOPHAGUS
VENTRAL NERVE CORD
7

The small gland cells form a compact group dorsal to the poorly-developed aorta, while the remains of the large gland cells form masses on each side of the latter. Ventral to the aorta, and slightly posterior to the dorsal group of small cells is the hypocerebral ganglion in which the nerve cell bodies represent the most important element. From their position, their relationships, and their innervation, the dorsal small cells will be seen to constitute the median corpus allatum of the type briefly described by Thomsen (1940). It is likewise definite by applying the above criteria to the condition in other insects that the large gland cells represent the corpora cardiaca, the reverse of the condition suggested by Scharrer and Hadorn. As further evidence of this conclusion it might be mentioned that the cells of the corpus allatum of ***Tipula abdominalis*** Say are smaller than those of the corpus cardiacum; also that in ***Tabanus atratus*** Fab. the corpus cardiacum cells are not contiguous with those of the corpus allatum, so there is less doubt of the homologies. It will be seen that the statement of Hanström (1939, p. 54) is most nearly in accord with the present conclusions, although he did not consider the small corpus allatum.

From the histological picture it seems most probable that the corpus allatum cells are not very active in the larva, while, as mentioned previously, the corpus cardiacum cells appear to be extremely active. (The recent results of Vogt, 1940b, might be considered evidence against this conclusion, for she has shown that the ***Drosophila melanogaster*** ring gland produces gonadotropic hormone at least a day before puparium formation). In the adult, however, the situation is reversed, and the corpus allatum is the most active organ, and is probably the source of the gonadotropic hormone reported by Vogt (1941b). In adult *Lucilia* several days of age large masses of fuchsinophil material, stable to the ingredients of alcoholic Bouin's fixative, appear first within the corpus cardiacum cells and later in the intercellular spaces. This material is considered to be products of secretion of these cells, but it is not known what might be its physiological significance. In older flies (more than 12 days of age) most of the material has again disappeared. During this time, however, no changes can be observed in the cells of the corpus allatum. They remain uniform in size, compact, and are difficult to differentiate. The nuclei have decreased in size from those of the early pupa (6 x 8 to 3 x 4 microns), consequent upon their increase in number.

There is one possible objection to the above conclusions. The only portion of the "ring" of the adult possessing the characteristic bluish appearance which typifies the living corpora cardiaca of a number of insects (and also the sinus gland of Crustacea), is the ventral part which has been considered to represent principally the cells of the hypocerebral ganglion. It might be added, however, that none of the cells of the larval ring gland exhibit this bluish appearance. If this characteristic be considered significant, it would be necessary to conclude that the large gland cells of the larva, and the remains of these cells in the adult, represent a development which is confined to the higher Diptera.

DISCUSSION

There have been so few observations on the function of the corpus cardiacum in other insects, and the conditions in the higher Diptera are so aberrant, that comparisons are difficult to evaluate. There is much evidence, however, that insect hormones are frequently non-specific. Removal of the corpus cardiacum of ***Melanoplus*** seems to cause some delay in moulting (Pfeiffer, 1939). Again, if the nerve cell bodies of the NCC I are in the pars intercerebralis, it is possible that the removal of this region in ***Rhodnius***, as was done by Wigglesworth (1940), results in altered secretion of the corpus cardiacum, though his conclusions are substantiated by the results of transplanting the pars intercerebralis. Although puparium formation follows shortly after the vacuolization of the corpus cardiacum cells, as reported by Burtt (1937) and confirmed in this study, the larva undergoes a further moult within the puparium, and it may be that these changes are more directly concerned with the moulting process than with that of puparium formation. Nevertheless, puparium formation is definitely under the control of a hormone (*cf.* Fraenkel, 1935; Plagge and Becker, 1938; and others). The experiments of Burtt (1938) and Hadorn (1937) demonstrate that it is probably the ring gland which is the source of this secretion. It is believed, however, that the processes going on at this time are far too complex for any simple explanation to be considered adequate. Nothing has been published on the effects of the corpus cardiacum in adult insects, except that it hypertrophies along with the corpus allatum in the reproductive castes of termites (Pflugfelder, 1937). Numerous experiments, however, have indicated that the corpus allatum may exert some effects in the adult on the maturing of the eggs and on secretion in the oviducts. And more specifically, the results of Thomsen (1940), indicating that there is a reciprocal action between the ovaries and the corpus allatum of flies, suggest that the latter gland is particularly concerned with the sexual processes in these insects. While the results of Vogt (1940a) are significant in this connection, it is not possible to determine from her experiments which portion of the ring gland is active in inducing development of ovaries in the heteroplastic transplants which she describes. In a more recent work Vogt (1941a) has described changes in the ring gland of ***Drosophila melanogaster*** occurring during pupal development which are not dissimilar to those described above. However, Vogt has referred to the corpus allatum cells as "median ganglion."

SUMMARY

The ring gland of the full-grown larva of *Lucilia sericata* Meig. is described. From the fate of the cell types as they are transformed into the adult corpus allatum and corpora cardiaca, it is concluded that the large ring gland cells are the corpus cardiacum cells. A median group of small cells dorsal to the aorta increases in size, and the cells increase in number by mitosis during pupal development to form the median corpus allatum of the adult. Some histological changes in the cells during development are described.

The bearing of these conclusions on our present knowledge of insect hormones is briefly discussed.

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ANOPHELES (NYSSORHYNCHUS) SAWYERI, A NEW ANOPHELINE MOSQUITO FROM CEARA, BRAZIL[1]

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One of the most widely distributed anophelines of the *Nyssorhynchus* group is *Anopheles argyritarsis* Robineau-Desvoidy. Although the species has been recognized for more than one hundred years, no very closely related forms have been described from its wide range throughout the Neotropical region. There is evidence accumulating, however, to indicate that with future intensified studies on biological and morphological characters the mosquitoes now designated as *Anopheles argyritarsis* will be classified in a number of valid species.

Such a new species has recently been discovered in Brazil among specimens collected in an anopheline survey. Examination of eggs, larvae, pupae, adult coloration, and male genitalia revealed characters which clearly separate it from *A. argyritarsis*. We herewith describe the species and name it *Anopheles* (*Nyssorhynchus*) *sawyeri*, in honor of Dr. Wilbur A. Sawyer, director of the International Health Division of The Rockefeller Foundation.

The type specimen and paratypes were bred out in the laboratory from eggs collected from wild females captured on horse bait on the high plateau of Serra da Ibiapaba near São Benedito in Ceará. So far the new species has been encountered only in this area, although extensive regions of Northeast Brazil have been surveyed. Since the type locality is apparently free of malaria, and the mosquito was never abundant and never found inside houses, *Anopheles sawyeri* is not suspected of being a vector. The holotype female and paratype males and females, larvae, and larval and pupal pelts have been deposited in the National Museum of the United States in Washington, D. C. Paratypes, larvae, and larval and pupal pelts are also deposited in the Oswaldo Cruz Institute in Rio de Janeiro.

DESCRIPTION OF ADULT

FEMALE: *Vertex.*—Very long, narrow white setae; white scales of median portion much shorter and broader, semierect; row of white scales around eyes still smaller, recumbent.

Occiput.—Abundant, compact, large, broad, erect, truncate scales, some notched at tip; scales of median and anterior portions white or yellowish; scales at lateral portions black.

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[1]The studies herewith reported were part of the program of the Serviço de Malaria do Nordeste maintained jointly by the Ministry of Education and Health of Brazil and the International Health Division of The Rockefeller Foundation.

Proboscis.—Dark brown, almost black.

Palpus.—Segment I with black erect scales; segment II with black semierect scales except for narrow white apical ring; segment III with black recumbent scales, and apical ring of white scales. Segment IV all black; segment V all white (Plate I, fig. 2).

Antenna.—Torus dark, with few small white scales; first segment of flagellum with more numerous white scales, some much larger than others; remainder of flagellum scaleless, but covered with very small delicate pale hairs; long dark setae at articulations of joints.

Anterior pronotum.—Compact group of large, erect, truncate, black scales at anterior portion; remaining portion sparsely clothed with long dark setae.

Posterior pronotum.—Bare.

Propleura.—Few long dark setae.

Mesopleura—Bare.

Sternopleura.—Group of larger white scales below middle of sclerite, close to posterior margin, and another at upper portion; few dark setae near scales.

Mesoepimeron.—Row of long pale setae at upper portion.

Mesonotum.—Triangular dark spot at prescutellar space, and smaller rounded spot at each side, posterior to lateral fossae; vestiture composed of white recumbent scales.

Scutellum.—Integument dark at median portion and paler at sides; clothed with recumbent white scales like those of mesonotum and with dark bristles; row of long dark bristles along posterior margin.

Abdomen.—Except on sternite I, clothed with numerous long dark bristles, largest at posterior portion of tergite I. Inconspicuous posterior lateral tufts of dark scales on segments III to VII. Tergite I scaleless; tergite II with triangular area formed by yellow and white recumbent scales; tergites III to VII with gradually larger and less triangular pale areas; tergite VIII with broad basal band of yellowish scales; narrow row of lighter scales at posterior margin. Sternite I bare; sternite II without dark scales and with two longitudinal submedian areas shorter than sternite; sternite III with very rare dark recumbent scales near anterior margin close to median line, and white scales chiefly distributed near posterior corners; sternites IV and V with more numerous dark scales at posterior margin, and white scales forming three groups, two near posterior corners and third at median line slightly before middle; sparse scales on remaining portions; sternite VI with dark scales at posterior margin, and white scales forming elongate median patch, two patches at posterior corners, and two submedian patches close to anterior margin; sternite VII with abundant black scales at posterior margin; white scales in longitudinal patch extending to anterior margin, and in submedian patches at anterior margin; sternite VIII with black scales more abundant than on VII, and with scales forming two longitudinal bands from anterior to posterior margins, close to lateral margins. Cerci clothed dorsally with dark brown or black scales at outer portion

and white (few yellowish) scales at inner portion; ventral surface largely covered with dark scales; white scales only at apex and on small distal portion at inner margin.

Front tarsi.—Segment I dark at outer portion except for narrow white apical band, inner portion with line of white scales; segment II black with apical portion about two-sevenths white; segment III black with very small white apical ring; segments IV and V entirely dark.

Mid tarsi.—Dark except for few scattered pale scales at apex of first and second segments, in some specimens all black.

Hind tarsi.—Segment I dark on outer portion, light on inner portion, except on distal third where dark scales predominate, apex black; segment II with basal black portion measuring 19 per cent of entire length in type specimen, remainder white, black portion 8 to 24 per cent in other specimens; segments III, IV, and V white (Plate I, figs. 3a, b, c).

Wing.—Pale portions formed by white scales, dark areas formed by coal black scales. Costa: B1 large, B2 much smaller than B1 but larger than preceding black spot, which does not reach humeral cross vein; B3 narrow, much smaller than preceding black portion; M1 usually absent, M2 approximately size of B2; Sc less than one quarter length of preceding black portion; Ap larger than Sc.

Subcosta.—Base pale, M1 present, M2 sometimes present, the remainder black.

First vein.—Base white, M1 as on subcosta, M2 slightly larger, Sc much larger than on costa, Ap slightly larger than on costa, apex with small black spot.

Second vein.—Stem with small basal black ring, followed by white spot corresponding to M2 of first vein; large black area extending to base of third vein followed by two alternate white and black areas, the last black area largest and extending to fork of vein; upper branch with small basal white spot followed by large black spot, with another white spot corresponding to Ap on first vein but smaller, another black spot of about size of preceding white spot; lower branch with small white basal area, followed by two black and two white alternate spots, tip white.

Third vein.—White, with rather broad subbasal and narrower sub-apical black spots.

Fourth vein.—Stem white with large black area beginning basal to level of insertion of second vein, and smaller black area at apex; upper branch with small basal white spot followed by two black and two white alternate spots; lower branch, base and apex white, with intermediate black portion.

Fifth vein.—Stem white, with subapical black spot; upper branch predominantly white, with two small black spots on basal half and third spot near apex; lower branch white, with subapical black spot.

Sixth vein.—White, with small black spot near base and a larger black area near apex.

Fringe formed by brownish-gray scales and white scales at portions corresponding to tips of longitudinal veins (Plate I, fig. 1).

MALE GENITALIA: In general similar to *A. argyritarsis*, differing principally in structure of mesosome and fused dorsal lobes. Membranous tip of mesosome longer and more pointed than in *argyritarsis*. Leaflets narrow, straight, serrated, closely approximated to lateral surface of mesosome, rarely incurved as in *argyritarsis* (Plate II, figs. 6a, 6b, 7). Apex of fused dorsal lobes very broad; outer corners sharply rounded with deep excavation of apical border (Plate II, fig. 8). Easily distinguished from *argyritarsis* which has a narrower apex with low rounded corners and shallow excavation (Plate II, fig. 9).

DIFFERENTIATION FROM A. ARGYRITARSIS: The 100 female specimens of *Anopheles sawyeri* studied are very much like the 47 specimens of *Anopheles argyritarsis* collected in Ceará and Rio de Janeiro. However, there seems to be a larger amount of white on the costal portion of the wings of *argyritarsis*, especially in specimens from Rio de Janeiro. The B2, for instance, in the majority of *argyritarsis* is much larger than the preceding black spot (two or three times larger or more, since B1 and B2 are sometimes fused); in the majority of specimens of *A. sawyeri* B2 is less than twice the size of the preceding black spot. Spot M1 was absent in 91, vestigial in 5, and present in 4 out of 100 specimens of *A. sawyeri*, while present or vestigial in 39 of 47 specimens of *A. argyritarsis* examined.

DESCRIPTION OF IMMATURE STAGES

EGG:—Floats absent; general size and shape of egg similar to *A. argyritarsis*, but with slightly greater concavity of dorsal surface (Plate III, fig. 11). Anterior end somewhat broader than posterior end. Exochorion dark, showing hexagonal pattern on dorsal surface enclosed by frill (Plate III, fig. 10). Wide frill continuous around entire dorsolateral area, much broader at ends (Plate I, figs. 4 and 5).

LARVA:—Inner clypeal hairs very close together, long and slender, with few and minute lateral branchlets. Outer clypeal hairs much shorter than inner ones, with few delicate lateral branches usually more conspicuous than those on inner hairs.

Posterior clypeal hairs long and slender, usually single, sometimes bifid.

Terminal hair of antenna long and slender, usually single, sometimes trifid.

Antennal hair situated on distal portion of basal quarter of antenna; small, with about 5 branches.

Inner submedian prothoracic hair with 9 to 15 filamentous branches.

Basal spines of pleural groups of hairs stout and very short.

Palmate hair of metathorax with about 10 filamentous leaflets.

Palmate hair of first abdominal segment with about 12 filamentous leaflets lightly chitinized; palmate hairs of abdominal segments II to VII with enlarged flattened, well chitinized leaflets, having very sharp and long almost filamentous tips (Plate III, fig. 12). Tips on corresponding leaflets of *A. argyritarsis* shorter and thicker.

PUPA:—Trumpet relatively long and narrow with little distal expansion (Plate IV, fig. 13).

Hair A minute and transparent on segment II; usually slightly larger and darker on segment III; larger, blunt, and well chitinized on segment IV; very long, well chitinized, usually slightly curved, and with tapering tips on segments V to VIII (Plate IV, fig. 14). Hair A on segment IV about one-eighth length of segment, slightly more than one-half length of segment on V and VIII, longer on VI; usually shorter and sometimes bifid or with few irregular external spinous branches on VIII (Plate IV, fig. 16).

Pupa of *sawyeri* differs from *A. argyritarsis* in proportional length of hair A on segments IV and V. Hair A on segment IV of *A. sawyeri* is usually less than one-fifth length of same hair on segment V, while in *A. argyritarsis* hair A on segment IV is more than one-fifth length of hair A on segment V (Plate IV, fig. 15).

Paddle of *sawyeri* is pear-shaped, proportion of length to width about 1.5. Outer margin with a row of very small teeth beginning near middle and grading into a fringe of delicate but conspicuous hairs extending to distal tip of margin; inner margin entirely bare. Terminal hair rather long, single, and strongly hooked; accessory hair very slender (Plate IV, fig. 17).

SUMMARY

Eggs, larvae, pupae, adult female, and male genitalia are described and figured from *Anopheles* (*Nyssorhynchus*) *sawyeri*, a new species of anopheline from Northeast Brazil. *Anopheles sawyeri* resembles *Anopheles argyritarsis* but can be differentiated from it in all stages of the life cycle, and by the male genitalia. The new species was found only on one plateau, in small numbers and feeding only on animal bait. It is therefore not suspected of being a malaria vector.

EXPLANATION OF PLATES

PLATE I

(Camera lucida drawings)

Fig. 1. Wing, female, *A. sawyeri*. Fig. 2. Palpus, female, *A. sawyeri*. Fig. 3. Tarsi. a. front, b. middle, c. hind, female, *A. sawyeri*. Fig. 4. Egg, lateral view, *A. sawyeri*. Fig. 5. Egg, dorsal view, *A. sawyeri*.

PLATE II

(Microphotographs)

Fig. 6. a. male genitalia, mesosome, *A. sawyeri*; b. same with one leaflet displaced. Fig. 7. Male genitalia, mesosome, *A. argyritarsis*. Fig. 8. Male genitalia, dorsal lobes, *A. sawyeri*. Fig. 9. Male genitalia, dorsal lobes, *A. argyritarsis*.

PLATE III

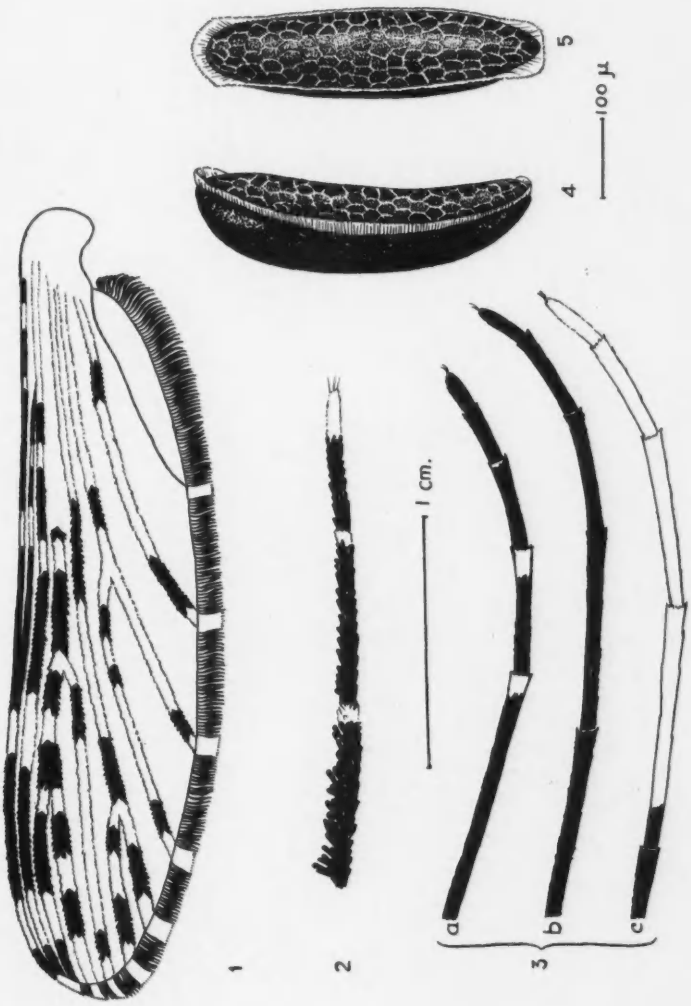
(Microphotographs)

Fig. 10. Eggs, dorsal view, *A. sawyeri*. Fig. 11. Egg, lateral view, *A. sawyeri*. Fig. 12. Larva, palmate hair, *A. sawyeri*.

PLATE IV

(Camera lucida drawings)

Fig. 13. Pupa, trumpet, *A. sawyeri*. Fig. 14. Pupa, hair A of abdominal segments II to VIII, *A. sawyeri*. Fig. 15. Pupa, hair A of abdominal segments IV and V, *A. argyritarsis*. Fig. 16. Pupa, relative lengths of hair A and abdominal segments IV to VIII, *A. sawyeri*. Fig. 17. Pupa, paddle, *A. sawyeri*.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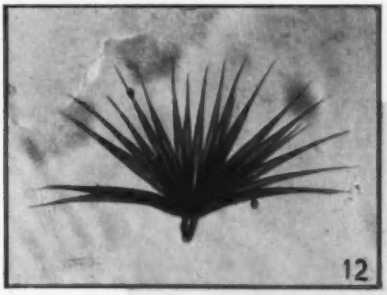
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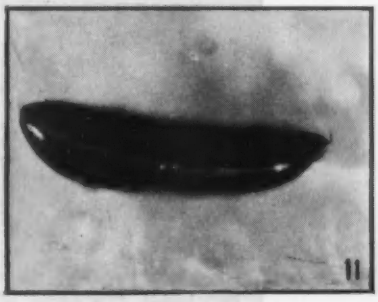
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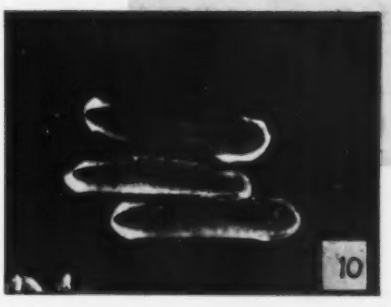
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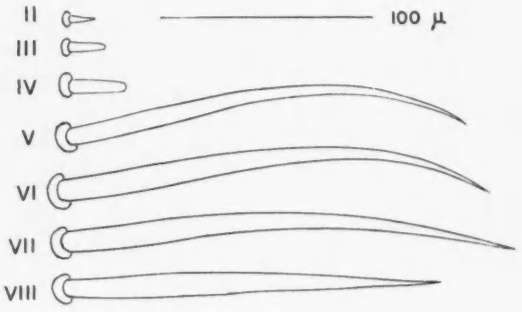

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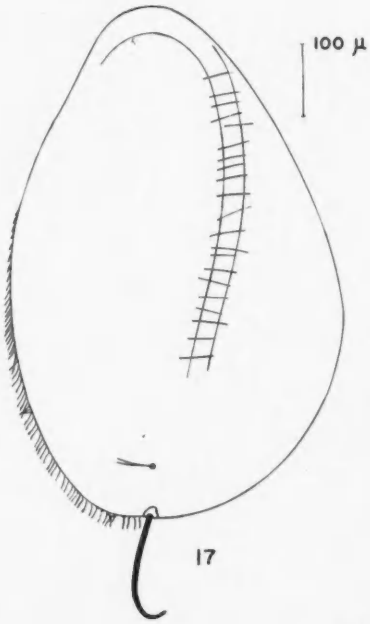

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MOSQUITOES AS VECTORS OF DERMATOBIA IN EASTERN COLOMBIA[1]

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The "human warble fly" (*Dermatobia hominis*) seems to be particularly common in the forest zone at the base of the Eastern Andes in Colombia, and in the course of yellow fever work in this zone observations have been accumulated on this warble fly that may be of general interest. In making routine captures of mosquitoes in several areas near Villavicencio for the purpose of checking on seasonal and habitat changes, the incidence of mosquitoes with *Dermatobia* eggs was noted on the record sheets. From these it has been possible to compute the relative frequency of infestation of different mosquito species. It has also often been possible to observe the behavior of the adult *Dermatobia* while ovipositing, and as accounts of this behavior in the literature are in part conflicting, a summary of the observations made is included in the present paper. This insect's oviposition habits are of great biological interest, entailing a curious vector relationship with mosquitoes and other flies; the behavior of the adult *Dermatobia* is surely as complicated and as inexplicable as that of any known insect, comparable to the highly specialized behavior patterns of some of the Hymenoptera.

The literature on *Dermatobia* is extensive, but refers for the most part to incidence on mammalian hosts and to the identification of insects on which the eggs have been found. The most detailed accounts of the bionomics of the fly are by Sambon (1915, 1922) and Neiva and Gomes (1917). Peña and Kumm (1939) have published some excellent photographs of mosquitoes bearing *Dermatobia* eggs. The insect is a major pest of cattle in many parts of Colombia, and detailed studies would be fully warranted from the agricultural point of view.

OVIPOSITION BEHAVIOR

The adult *Dermatobia* female, when ready to lay eggs, appears to be attracted to warm-blooded animals; these females have often been observed both on field workers and on their horses. The following, for instance, is an abstract from field notes: "Observed an adult *Dermatobia* on the flank of my horse in the Bosque Ocoa; she oviposited on four muscoid flies in a period of 45 minutes. She stationed herself on the horse's flank, making short flights from time to time, changing occasionally from one side of the horse to the other. The small flies were captured as they approached the *Dermatobia;* when they were perhaps a centimeter away she would pounce on them, catching them in mid-air; the

[1]The studies and observations on which this paper is based were conducted with the support and under the auspices of the Section of Special Studies maintained by the Ministry of Labor, Hygiene, and Social Welfare of the Republic of Colombia and the International Health Division of The Rockefeller Foundation.

flies were held closely under the thorax of the *Dermatobia* while she hovered; the oviposition process required approximately one minute."

The *Dermatobia* are quite fearless and on one occasion I spent some time playing with a female that lit on my shoulder. I induced her to crawl onto the tip of a finger and then tried bringing her close to mosquitoes that were feeding. She seemed quite indifferent to a stationary mosquito and even when the mosquitoes flew away after feeding, the *Dermatobia* usually did not give chase. I finally placed her on the bare foot of one of the men, where several mosquitoes were feeding. The *Dermatobia* seemed to react to the mosquitoes only when they moved, and was thus most likely to attempt to catch them when they first lit. In this position the *Dermatobia* was so close to the ground that when she caught a mosquito she was likely to strike the ground while attempting to hover; she completed the ovispoition process twice while lying in the leaves after such contretemps, and I was able to observe the action with a hand lens. The mosquito was grasped firmly in all six legs of the *Dermatobia* and pressed, head forward and back up, against her thorax; the eggs were then planted in rapid succession on the abdomen of the vector, this site being easily reached by the curving abdomen of the *Dermatobia*. The process is clearly normally carried out while hovering, and it was only when the vector was already properly oriented and actual oviposition started that the pattern was not broken by striking the ground.

The *Dermatobia* adults often have difficulty in handling their captures and they frequently fail to complete the oviposition process. The first action after capturing a potential vector is to turn it about to get it properly oriented for oviposition, and it is often lost in this period; my impression is that *Dermatobia* cannot handle a potential vector that is too large, too small, or too active. Large flies are sometimes captured but escape, and I have seen *Haemagogus* escape in the pre-oviposition struggle, so it may be that this species is too small to be a satisfactory vector.

I have found *Dermatobia* adults only in forest and during midday hours. Twice, however, flies that have stationed themselves on my shoulders while I was working in the forest have remained in position during a two kilometer walk from the forest station to the highway, the latter half of the walk being across sunny pasture. Once also, after leaving a forest, a *Dermatobia* stayed on my horse over several kilometers of open road.

INCIDENCE OF EGGS ON MOSQUITOES

Small calypterate flies are probably as frequently vectors of *Dermatobia* as are mosquitoes; but to establish rates for these flies it would be necessary to catch all of the flies that hover about one while in the forest. As the primary aim has been to study mosquitoes, no attempt has been made to collect zoophilous flies in general. The mosquito fauna of the Villavicencio area has been described in papers by Komp (1936) and Antunes (1937); the nomenclature used here corresponds to theirs, except that *Wyeomyia* is used in the wide sense of Edwards (1932).

The incidence of *Dermatobia* eggs on mosquitoes varies according to locality and mosquito species. The highest rate is in a small forest near the laboratory called the "Bosque Ocoa"; this forest is partly second

growth and partly a somewhat cutover remnant of what might be called the "plains forest," a forest that probably originally covered the level ground from the base of the eastern Andes for a distance of twenty or thirty kilometers into the llanos but which, in the vicinity of towns and roads, has been almost entirely cleared. This type of forest is characterized by an abundance of ground-pool breeding mosquitoes (especially *Psorophora ferox* and *Aedes serratus*) which are rare in the better drained foothill forest. Infestation rates in the Bosque Ocoa were:

Species	Number Examined	Number Infested	Per Cent Infested
Psorophora ferox	822	69	8.4
Aedes serratus	1,172	26	2.2
Haemagogus capricorni	128	0	0
Miscellaneous sabethines	866	2	0.2

The sabethines were very largely *Wyeomyia;* both specimens with eggs belonged to that genus. *Psorophora ferox* were caught with eggs during every month of the year, but the numbers for each month were too small to show possible seasonal variations. A stable trap, baited with a donkey, was run on three nights a week in a clearing in this forest. *Dermatobia* infestations on mosquitoes caught in the trap during a year of collections were as follows:

Species	Number Examined	Number Infested	Per Cent Infested
Psorophora ferox	122	2	1.6
Aedes serratus	1,669	4	0.2
Miscellaneous sabethines	516	1	0.2
Anopheles rangeli	22,116	0	0
Mansonia spp.	3,799	3	0.1
Psorophora cingulata	7,997	5	0.1

The difference in infestation between the day captures and the trap captures in *Psorophora ferox* and *Aedes serratus* is significant. These species enter the trap in numbers only during periods of great abundance (at the time of the first rains, for instance) so that the majority of specimens so caught may be recently emerged and thus less likely to be infested. The *Mansonia* are almost exclusively a species that seems to be *justamansonia*, which is never taken in the day captures; *Psorophora cingulata* is very rare in the day captures also, and the crepuscular habit may account for the low infestation rate in both of these species. The sabethines were again mostly *Wyeomyia*, and the one specimen with eggs belonged to that genus.

Regular day captures were made in an area of foothill forest which we call "La Forzosa" (all forests mentioned here are subdivisions of the general class of "lower tropical rain forest"). There, because of the complete drainage, ground-pool breeders are very rare and the fauna is composed almost exclusively of mosquitoes that breed in "natural containers." The infestation rates were:

Species	Number Examined	Number Infested	Per Cent Infested
Psorophora ferox	137	0	0
Aedes serratus	43	1	2.3
Haemagogus capricorni	8,628	3	0.03
Wyeomyia spp.	1,992	10	0.5
Anopheles boliviensis	318	1	0.3

The only other mosquito caught in the area with *Dermatobia* eggs was a specimen of the rather rare *Trichoprosopon lampropus*.

It is apparent that *Dermatobia* is relatively scarce in the Forzosa area. Presumably cattle are the chief mammalian host and the two forest areas are about equally distant from pastures (about a kilometer in each case). The Ocoa forest is on the highroad along which thousands of cattle are driven and the *Dermatobia* might come from these passing animals. Yet, in a series of captures made in a small patch of second growth along this same highroad, surrounded with cattle pastures, a rate of only 0.7% on *Psorophora ferox* (3 in 448) was found. A similar great difference was observed between two forests near the town of Acacias, in the course of a short study there: in one forest 11 of 263 *Psorophora ferox* carried eggs of *Dermatobia;* in the other, none of 346 *Psorophora ferox*. In this case both were "plains forests," but the one with the high *Dermatobia* rate was much cut over, and had somewhat larger numbers of cattle in the immediate vicinity.

DISCUSSION AND SUMMARY

The adult female of *Dermatobia hominis*, when ready to lay eggs, is zoophilous in that she is attracted to warm-blooded animals; taking up a position on a man or a horse, she seizes other zoophilous flies and lays her eggs on them. From observations of the oviposition behavior and from the relative incidence of eggs on different species of mosquitoes, it would seem that the characteristics of a vector of *Dermatobia* eggs are: (a) zoophilous habit; (b) diurnal flying period; (c) moderate size (for instance most Tabanids would be too large to handle, *Hippelates* too small); (d) moderately active habits (very sluggish insects would not stimulate the pouncing behavior in *Dermatobia*, and very active ones would escape). Both *Dermatobia* and its vectors seem to be forest insects, though *Dermatobia* will occasionally leave the forest accompanying a host. The *Dermatobia* abundance may differ strikingly from forest to forest with no obvious relation to the abundance of cattle (assumed to be the chief host) in the vicinity.

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FURTHER STUDIES ON OOTHECAE OF INTRODUCED ASIATIC MANTIDS

(Orthoptera: Mantidae)[1]

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The writer (1939a) published the results of a study of the oothecae of two species of Asiatic mantids established in this country. That study comprised observations on three lots of *Tenodera sinensis* Saussure and one of *T. angustipennis* Saussure. Of the former, two lots came from the Bronx section of New York City, one collected late in 1937, the other early in 1938. The third lot and the entire series of *T. angustipennis* were gathered late in 1937 at Ocean View, New Jersey. Since some of the conclusions based upon that material were provisional, their validity has been tested by an examination of additional material from the same localities.

MATERIAL

The oothecae consisted of two lots of *T. sinensis* and one of *T. angustipennis*. Fifty-three oothecae of the former species and 88 of the latter were collected late in December, 1938, at Ocean View. Sixty-seven oothecae of *T. sinensis* were collected in mid-March, 1938, in the Bronx section of New York City.

PROCEDURE

Most of the oothecae were promptly placed separately in glass jars, where they remained at room temperature until nymphal emergence had ended. Since jars were not available for the entire series obtained at Ocean View, part of the material from that locality was temporarily stored in an electric refrigerator. Development was thereby inhibited. Such procedure eliminated the complication which, in the previously reported experiments, arose as a result of exposing part of the eggs to cold after they had reached an advanced stage of development.

In the earlier work all oothecae were left dry during the entire period of observation. To reduce evaporation, the jars containing the oothecae were kept closed by fastening the glass lids in place by the metal clips, but omitting the rubber rings, thereby leaving the lids loose enough to allow a slow interchange of air between the interior of the jars and their surroundings. However, since under these conditions the loss of moisture from the oothecae might affect nymphal emergence, a modified procedure was adopted in part of the later series of experiments. All the oothecae from Ocean View which were kept uninterruptedly at developmental temperatures were sorted into two lots of nearly equal numbers. One lot was left dry to serve as a check,

[1]Contribution from the Department of Biology, University College, New York University.

while the other was moistened once each week by dipping the oothecae in tap water for about a minute and promptly replacing them in the jars. Traces of the moisture thereby introduced were often detectable in the jars for two to three days. Under natural conditions the oothecae are ordinarily dry on the surface and are only wetted during periods of damp or rainy weather. It was, therefore, inferred that alternate wetting and drying would more nearly approximate natural conditions than constant exposure to a high humidity, which might promote the growth of Fungi on the oothecae.

In every case, along with the total number of nymphs emerging from an ootheca, separate records were kept of those which appeared to be viable and of others which were moribund or otherwise defective. After emergence had ended, the oothecae, as in the earlier experiments, were dissected under a binocular and counts made of the number of eggs which had not developed and of nymphs which had either died within the egg or had perished while still inside the ootheca.

TABLE I

Number of Eggs in Oothecae of *Tenodera*, 1938

Source	Number of Oothecae	Number of Eggs			
		Total	Mean	Minimum	Maximum
T. sinensis					
Bronx	67	17,493	261.1 ± 3.5	154	338
"	59	15,439	261.7 ± 3.7	154	338
Ocean View	53	15,689	296.0 ± 5.7	172	423
" "	51	15,211	298.2 ± 5.7	172	423
T. angustipennis					
Ocean View	88	20,988	238.5 ± 3.9	36	373
" "	84	20,264	241.2 ± 3.7	129	373

OBSERVATIONS AND REMARKS

Number of Eggs.—Records of the number of eggs present in the oothecae examined are summarized in Table I.

Each lot of oothecae is listed twice. In each the results first given are based upon the entire lot, those on the second line upon the oothecae from which nymphs emerged. It is evident that by either selection nearly identical means are obtained.

Comparison of these results with those previously published (Fox, 1939a, Table I) shows close agreement between comparable lots. However, contrary to the negative view favored in the writer's earlier paper, the difference between the mean of *T. sinensis* from the Bronx and that of the same species from Ocean View is now found to be statistically significant, being considerably more than thrice its probable error. Since in the earlier work the significance of the difference was uncertain and since the figures here published are based upon a much larger sample from Ocean View, the conclusion seems warranted that

oothecae of *T. sinensis* from the last named locality contain significantly larger numbers of eggs than those from the Bronx section of New York City. Whether this difference, apparently correlated with latitude, would hold if material from a wider range of localities had been selected is a query incapable of a definite answer in the light of the present evidence, but the result suggests at least the probability of an increased egg production in the more southern portions of the insect's range.

Of the 14 oothecae from which no nymphs emerged, 7 contained eggs which showed no certain traces of development. Of these, six belonged to *T. sinensis*, the other to *T. angustipennis*. Among them only a single ootheca from the Bronx was obviously abnormal, with the inner capsule unformed and the eggs distributed promiscuously through the general matrix. In the remaining oothecae, from which nymphs failed to emerge, only a limited proportion of the eggs showed signs of development.

No change from that previously recorded was noted in the number of eggs in the oothecae of *T. sinensis* from the Bronx. However, in the material of both species from Ocean View a noteworthy extension of the extremes was shown. In the earlier sample of *T. sinensis* from that locality the number of eggs per ootheca extended from 230 to 351, in the more recent sample from 172 to 423. In *T. angustipennis* the observed extremes in the older series were 93 and 335, in the present series 36 and 373.

Length of the Period of Incubation.—The only part of the period of incubation here taken into consideration is the time between the date when the oothecae were placed under observation and that on which nymphal emergence began. The full length of the developmental period was naturally indeterminable, since the oothecae when collected had already undergone some development previous to the advent of cold weather. Limiting consideration to oothecae which while under observation were continuously exposed to developmental temperatures, the average length of the period of incubation in 45 oothecae of *T. sinensis* from Ocean View was 29.7 days, with a minimum of 8 and a maximum of 48 days. There was a wide gap in this lot between the minimum, which was limited to a single ootheca, and the next following emergences which occurred on the 19th day (Table II). After the latter, emergence was of almost daily occurrence until the 41st day. In another lot of 59 oothecae of the same species from the Bronx the average was 34.4 days, with extremes of 30 and 50 days. In this case emergence was general between 30 and 44 days. In *T. angustipennis* a series of 50 oothecae gave 45.6 days as the average length, with a range from 39 to 64 days and emergence of general occurrence between the initial and 51st day.

Since the lot of oothecae of *T. sinensis* from Ocean View and the series of *T. angustipennis* were placed under observation simultaneously and hence developed under essentially identical conditions, it is clear that in the former development proceeds far more rapidly than in the latter. Fully 73 per cent of the oothecae of *T. sinensis* had yielded nymphs by the time emergence began in the other species. According to the field observations of the writer, adults of both species appear at

Ocean View in late August or early September and oviposition in both starts shortly thereafter. It, therefore, seems likely that the observed difference in the rate of development of their eggs is of genetic origin. However, the possibility also exists that it may have arisen in part from the conditions of the experiment. These, while evidently congenial to development in *T. sinensis*, were definitely less favorable to *T. angustipennis*, as is evidenced by the reduced emergence obtained in the latter, a subject more fully treated in a later section of this paper. At this point it suffices to state that a condition readily endurable by some species may prove relatively harmful to others and that one way in which the resultant injury may be expressed is in retarded embryonic development.

TABLE II

Correlation of Egg Content of Oothecae of *Tenodera* and Length of Period of Incubation

Period of Incubation (Days)	*T. sinensis* (Bronx)				*T. sinensis* (O. V.)				*T. angustipennis*			
	Number of Oothecae	Eggs per Ootheca			Number of Oothecae	Eggs per Ootheca			Number of Oothecae	Eggs per Ootheca		
		Mean	Min.	Max.		Mean	Min.	Max.		Mean	Min.	Max.
5- 9	0	.....	.....	.....	1	331.0	.....	.....	0	.....	.....	.....
10–14	0	.....	.....	.....	0	.....	.....	.....	0	.....	.....	.....
15–19	0	.....	.....	.....	3	331.3	216	423	0	.....	.....	.....
20–24	0	.....	.....	.....	6	354.0	329	411	0	.....	.....	.....
25–29	0	.....	.....	.....	11	318.1	236	399	0	.....	.....	.....
30–34	37	266.1	154	338	12	307.6	222	378	0	.....	.....	.....
35–39	13	265.2	208	334	8	258.3	195	302	1	266.0	.....	.....
40–44	8	239.3	208	292	2	257.0	177	337	19	276.4	129	373
45–49	0	.....	.....	.....	2	180.5	172	189	27	231.6	139	305
50–54	1	232.0	.....	.....	0	.....	.....	.....	1	167.0	.....	.....
55–59	0	.....	.....	.....	0	.....	.....	.....	0	.....	.....	.....
60–64	0	.....	.....	.....	0	.....	.....	.....	2	166.0	143	189
Total	59	.....	.....	.....	45	.....	.....	.....	50	.....	.....	.....

Correlation between Egg Content of Oothecae and the Length of the Period of Incubation.—The data bearing upon this point, which are taken exclusively from material kept continuously at room temperature, are summarized in Table II.

These results indicate a general inverse relation between the egg content of the oothecae and the length of the period of incubation. The explanation doubtless lies in the varying age of the oothecae when collected. In oothecae formed early in the season development would progress farther before the onset of winter than in those formed at a later period and would, therefore, hatch sooner when brought indoors. This inference is substantiated by the finding of fully formed nymphs, apparently about to hatch, in a few oothecae collected in mid-winter, when no trace of development was discernible to the unaided eye in the remaining oothecae. It was doubtless an ootheca in this condition which is shown in Table II as giving nymphal emergence within nine

days following its transfer to the laboratory. The results tabulated in Table II therefore suggest that, in general, the higher numbers of eggs pertain to the earlier produced oothecae, the reduced numbers to those later formed.

Nymphal Production and Emergence.—The data on the number of nymphs formed and the proportion emerging in the newer lots of oothecae are summarized in Table III. The tabulated figures are based solely upon material which was kept continuously at room temperatures.

In the writer's earlier paper the failure of part of the nymphs to emerge from the oothecae was noted. The number emerging is, therefore, usually less than the number formed and, even among them, some individuals are often found moribund or otherwise defective and

TABLE III

Nymphal Production and Emergence in Oothecae of *Tenodera*, 1938

Locality	Number of Oothecae	Nymphs				
		Number Formed	Number Emerging	Emergence		
				Total (Per Cent)[2]	Viable (Per Cent)[2]	Range of Viable (Per Cent)[2]
T. sinensis						
Bronx	59	13,956	13,207	94.6	93.8	22.0 — 100.0
Ocean View	45	12,844	12,084	94.1	93.5	43.6 — 100.0
T. angustipennis						
Ocean View	53	12,294	9,897	80.5	75.6	0(30.3) — 96.7

[2]In terms of the number formed.

incapable of survival. In Table III nymphs which on emergence appeared to be normal are termed viable and their percentage is listed separately from that of the total number emerging.

It is evident from the results that emergence and potential survival were considerably higher in *T. sinensis* than in *T. angustipennis*. The difference is close to that previously reported. In the earlier study (Fox, 1939a) the emerging nymphs of *T. sinensis* comprised from 96 to 97.6 per cent of those formed, while in *T. angustipennis* they comprised only 79.8 per cent. In the newer material the corresponding figures were from 94.1 to 94.6 per cent in *T. sinensis* and 80.5 per cent in *T. angustipennis*.

In the writer's former paper evidence was presented which suggested that the lower emergence in *T. angustipennis* might have resulted from exposure of some of the oothecae to cold at a critical stage of embryonic development. It was surmised that under like conditions the proportion of emerging nymphs in *T. angustipennis* would probably equal that obtained in *T. sinensis*. The newer evidence, which was obtained under similar conditions in both species, fails to substantiate that view and instead suggests that some experimental condition

capable of being withstood by the one species without perceptible injury may be definitely less favorable for the other.

The factor responsible for the difference noted in the nymphal emergence of the two species is probably traceable to the relative effectiveness of their oothecae in conserving the moisture content of the enclosed eggs. The ootheca of *T. sinensis* is remarkable for the unusual thickness and highly vesicular texture of its cortical covering, which is almost impervious to water (Weiss, 1914). In striking contrast, the same layer in *T. angustipennis* is thin and homogeneous. It therefore seems likely that, under conditions where evaporation is not prevented, the eggs of the former would be more securely protected against loss of the moisture essential for optimal development than would those of its congener.

Nymphal Emergence in Dry and Wetted Oothecae.—In view of the presumptive importance of evaporation in influencing nymphal emergence, a test was made in which, as earlier mentioned, emergence from oothecae kept permanently dry could be compared with that from others regularly wetted each week. The result showed that the difference in treatment had no effect upon emergence in *T. sinensus*, where the viable nymphs in the wetted oothecae formed 93.9 ± 1.3 per cent of the total produced, compared with 93.1 ± 1.9 per cent in the dry lot. In *T. angustipennis* an apparent improvement was empirically indicated, the viable nymphs in the moistened oothecae forming 80.0 ± 3.2 per cent of the total, in the dry 71.6 ± 3.2 per cent. However, in this species the range of variation in the emergence of individual oothecae was very wide and essentially identical in both lots, in positive cases ranging from 31.9 to 96.5 per cent in the wetted and from 30.3 to 96.7 per cent in the dry oothecae. This, along with the magnitude of the probable errors, precludes attaching statistical significance to the apparent difference.

Because of the inconclusive nature of the evidence from this test, it can scarcely be regarded as furnishing an adequate disproof of the view that the key to improved nymphal emergence in *T. angustipennis* lies in conserving the moisture content of the oothecae. It may well be that the brief wetting to which the oothecae were subjected did not allow enough moisture to soak through the surface to replace that previously lost and hence may have served as, at most, but a temporary check on continued loss through evaporation.

Emergence as Affected by Length of Period of Incubation.—Since experimental evidence no more conclusive than that just cited is at present available as a criterion of loss of moisture through evaporation as a potent factor in conditioning nymphal emergence, the writer has analysed the data of both the earlier and the present series of experiments to determine how far emergence was affected by the length of the period of incubation. The amount of moisture lost from this source is obviously a function of time of exposure. It is, therefore, a plausible inference that the longer the time required for incubation the greater would be the reduction in the proportion of emerging nymphs. The result of the analysis of the data in question was definitely negative as regards *T. sinensis*, a not unexpected outcome in view of the special structure of the ootheca in that species. In *T. angustipennis*, however,

some indications of a decreased emergence with a prolonged period of incubation were obtained. In the series of the latter species collected in 1937 the average emergence in 24 oothecae with an incubation period of from 40 to 49 days was 92.0±1.39 per cent, in 22 others with the same period ranging from 50 to 59 days it was 82.7 ± 2.24 per cent, and in a third lot of 20 oothecae, where the period extended from 60 to 69 days, it was 61.7 ± 2.78 per cent. In the series of the same species obtained in 1938 the average emergence in 70 oothecae with an incubation period of from 40 to 49 days was 79.2 ± 2.01 per cent. In the remaining groups of the latter series only five oothecae were represented and, although they gave emergences in accord with hypothetical expectation, the size of the samples leaves their statistical significance uncertain. The results with *T. angustipennis*, while perhaps not entirely conclusive, thus favor the view that the longer the period of incubation the less the percentage of emergence and thereby suggest progressive desiccation as the probable determining factor. However, there is need in this case for further study and it is hoped that future experimental investigation may throw clearer light upon the problem.

Effect upon Nymphal Emergence of Temporary Inhibition of Development by Cold.—It was mentioned earlier that part of the series of oothecae from Ocean View was temporarily stored in a refrigerator. Comparison of the results obtained with these oothecae with those of the check lot indicates a negative effect of the temporary inhibition of development by cold upon subsequent nymphal emergence. In the cold-exposed set of *T. sinensis* viable nymphs formed 91.0 per cent of the total number produced, compared with 93.1 per cent in the check, while in *T. angustipennis* the corresponding figures were 68.4 per cent in the cold-exposed set and 71.6 per cent in the check. The difference in each case is obviously too small to be significant. The period during which the oothecae were stored in the refrigerator varied from 34 to 52 days, although a few oothecae of *T. sinensis* were removed after only 8 days. No evidence was obtained to show that within these limits the precise duration of the storage made any difference in the extent of nymphal emergence.

Diurnal Periodicity in Emergence.—In the writer's earlier paper it was stated that nymphal emergence in both species of *Tenodera* exhibits the same general periodicity that Rau and Rau (1913) had described in *Stagmomantis*, the main difference being its extension in the former throughout the entire forenoon instead of terminating about 9 A. M. The data now available confirm the earlier observations insofar as they show emergence to be far more frequent in the forenoon than at other times during the day. However, in the more recent work, some exceptions to this rule were found, so distributed in their occurrence as to indicate that emergence may occur at almost any time. In some instances emergence occurred long after dark, the latest observed being about 11 P. M.

Infestation by Podagrion mantis Ashmead.—No instances of infestation of oothecae by this egg parasite were observed in this further study of *Tenodera* oothecae (Fox, 1939b).

SUMMARY

1. In a continued study of oothecae of two species of mantids of the genus *Tenodera*, based upon material collected, as before, in the Bronx section of New York City and at Ocean View, New Jersey, the average number of eggs per ootheca in each case was not significantly different from that previously recorded. Contrary to the earlier expressed view, the results in this later study strongly support the view that the difference between the average of *T. sinensis* from the Bronx and that of the same species from Ocean View is statistically significant and thus suggestive of a variation in the average egg content of the oothecae dependent upon differences in the latitudinal range of the species.

2. The range of variation in the egg content of oothecae of *T. sinensis* from the Bronx falls well within that earlier recorded, but in material of that species and of *T. angustipennis* from Ocean View a noteworthy extension of the range was shown. In the former the range was from 172 to 423, in the latter from 36 to 373.

3. The time required for incubation of the eggs in oothecae collected outdoors in winter averages considerably less in *T. sinensis* than in *T. angustipennis*. The difference is probably genetic, but the suggestion is made that environmental effects may also play a part, owing to the cortical covering in one species presumably serving as a more efficient protective device against progressive desiccation than in the other.

4. The number of eggs per ootheca shows an inverse correlation with the length of the period required for incubation under indoors conditions. The factor suggested as responsible is the seasonal sequence of deposition of the oothecae, the earlier oothecae having a higher egg content than those deposited later.

5. The proportion of nymphs emerging from the oothecae showed the same general disparity between the two species as was previously recorded, although both were reared under essentially identical conditions in the more recent study. The result thus fails to substantiate the earlier drawn inference that the lower emergence in *T. angustipennis* came from exposure of some of the oothecae of that species to cold at a critical stage in embryonic development, and instead suggests that experimental conditions apparently favorable for optimal emergence in one species may prove definitely less favorable in a different species.

6. The factor tentatively suggested as responsible for the observed disparity in nymphal emergence of the two species is the relative effectiveness of their oothecae in conserving the moisture content of the enclosed eggs, as indicated by differences in the thickness and texture of the cortical coats of the oothecae in the two species.

7. Nymphal emergence in oothecae wetted at weekly intervals, compared with that in others kept permanently dry, was inconclusive as a test of the importance of moisture conservation in determining nymphal emergence, although in *T. angustipennis* an apparent improvement was indicated in the moistened sample, but of too small a margin to be acceptable as conclusive.

8. The influence of the length of the period of incubation upon the extent of nymphal emergence was studied as a partial test of the hypothesis of progressive desiccation as the determining factor in the

potential survival of the emerging nymphs. The result was negative in *T. sinensis*, but in *T. angustipennis* some evidence was found of a decreased emergence with a lengthening of the period required for incubation.

9. Diurnal periodicity in nymphal emergence is indicated as generally prevalent during the forenoon, as previously observed, but some exceptions to the rule show that emergence may occur at other times during the day and in some instances even long after nightfall.

10. No cases of parasitism by *Podagrion mantis* were observed in the newer series of oothecae.

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A STUDY IN NEOTROPICAL PSELAPHIDAE, by ORLANDO PARK, 1942. Pages x and 403, 21 plates 7½x10¼ inches, cloth bound. Published as Studies in the Biological Sciences and Medicine, No. 1, by NORTHWESTERN UNIVERSITY. Price, postpaid, $7.50.

Professor Orlando Park has done much research on insects and other animals that live with ants and termites. "This volume is not a monograph. It is a summary of data preparatory to monographic study. The author has attempted to co-ordinate and add to the information on the Pselaphidae which inhabit the American tropics."

As a general introduction seven pages are given to generalities on the two types of life, that of the mould species and the habits of the forms which inhabit ant nests. In this part are given many hints for finding pselaphids in the field and methods of collecting. They feign death, look like particles of the soil and are generally difficult. Thus we know so little about them but many of the larger nests of common ants accommodate such guests in considerable variety.

Pselaphids are so small, 0.6–4.0 mm. in length, that they require special techniques of preservation and preparation for accurate description. Five pages cover these problems. Nineteen pages are devoted to a detailed guide to their taxonomic morphology, the curious characters that occur in various groups of genera. Some of this work uses the compound microscope up to several hundred diameters magnification. Further, "there is no qualitative criterion the application of which will separate all pselaphids from all staphylinids," again they are difficult.

Pages 31 to 358 are devoted to the seventeen tribes of Pselaphidae found in the Western Hemisphere, a tentative taxonomic treatment as a monograph cannot be written until much more is known of types, topotypes and material from the present unexplored areas. Fifty new species are described.

Pages 360 to 380 are titled "Zoogeography" and give comparisons of various pselaphid faunas, one with another, with suggestions as to relationships.

This large volume is a working manual for future students of Pselaphidae. It gives the writer a thrill to find such large scale help given out generously to other possible students. The constant teaching in several departments of entomology against hoarding in taxonomy at times appears to have had little effect as hoarding is a biproduct of collecting fragile material. But with the recent realization of the enormous numbers of undescribed inconspicuous insects we may lose some of the undesirable features of past taxonomic technique.—C. H. K.

TWO NEW CHRYSOBOTHRIS

(Buprestidae: Coleoptera)

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Chrysobothris culbersoniana n. sp.

Male.—Form, size and color of *C. deleta* Lec., piceous, with bronzy tinge, more strongly shining beneath; pubescence moderate on head, pronotum, ventral surface and legs, sparse on elytra.

Head bronzy, convex, longitudinal carina on vertex joining an obtuse V on front; front with two irregular smooth callosities; clypeus broadly emarginate; surface coarsely punctate; antennae feebly narrowed to apex, serrate from the fourth joint, third segment longer than fourth, outer segments wider than long.

Pronotum twice as wide as long, widest in front of middle, wider at base than at apex; sides strongly rounded; anterior margin slightly sinuate, median lobe broad; basal margin strongly emarginate each side, median lobe broadly rounded; disk convex; surface coarsely punctured, smooth callosities irregular, one median and two lateral ones in front being most prominent. Scutellum triangular, depressed.

Elytra at base wider than widest part of pronotum; sides subparallel to middle, widened back of middle, then converging to rounded apices; lateral margins serrulate; basal depression broad; surface irregularly punctate, each elytron with four irregular costae interrupted by two foveae, costae more prominent posteriorly.

Abdomen beneath densely, finely punctured, each sternite with a smooth callosity on each side near lateral margin, last visible sternite broadly emarginate, lateral margin serrulate. Prosternum without a lobe. Anterior femur with an acute tooth. Anterior tibia arcuate, a small tooth near apex, other tibiae straight.

Length 6.5 mm.; width 2.5 mm.

Described from two male specimens collected in Culberson Co., Tex., May 10, 1941, by D. J. & J. N. Knull, in collection of the writer.

This species should be placed near *C. deleta* Lec. according to Fisher's arrangement[1] of the genus. Lack of pubescence on elytra and prosternal lobe separate it from the closely allied forms.

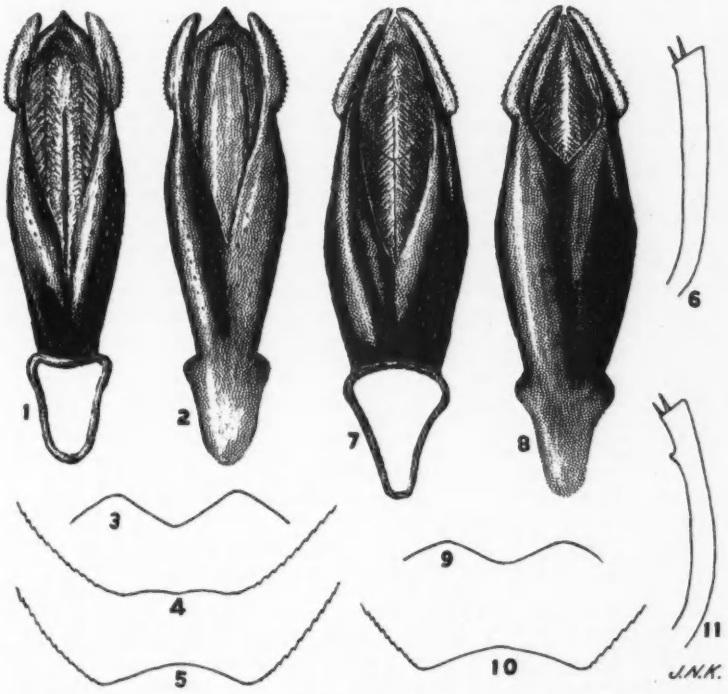
Chrysobothris crandalli n. sp.

Male.—Resembling *C. deserta* Horn in size and form. Convex, brownish cupreous above; foveae of elytra and ventral surface cupreous; front brilliant green; occiput and apical margin of pronotum bright cupreous; pubescence of entire insect well indicated.

[1]W. S. Fisher, U. S. D. A. Misc. Pub. 470, pp. 1–274, 1942.

Head convex, a carina on occiput, a small smooth callosity on front on each side; surface densely punctate, pubescence long; clypeus broadly emarginate, antennae short, outer segments compact, wider than long, third joint not as long as the two following joints together.

Pronotum wider than long, wider at base than at apex, widest in middle; sides broadly rounded; anterior margin sinuate, median lobe rounded; base more strongly emarginate, median lobe broadly



Chrysobothris crandalli n. sp. 1. Dorsal view of male genitalia. 2. Ventral view of male genitalia. 3. Clypeus. 4. Last visible abdominal sternite of female. 5. Last visible abdominal sternite of male. 6. Anterior tibia of male.

Chrysobothris culbersoniana n. sp. 7. Dorsal view of male genitalia. 8. Ventral view of male genitalia. 9. Clypeus. 10. Last visible abdominal sternite of male. 11. Anterior tibia of male.

rounded; disk convex, a large smooth callosity in each side in front of middle; surface very coarsely punctate, pubescence long. Scutellum triangular, glabrous.

Elytra at base wider than widest part of pronotum, widest back of middle; sides nearly parallel near base, expanded behind middle, then arcuately rounded to rounded apices; lateral margins serrate

posteriorly; disk convex, basal depression well marked, humeral depressions slight; surface scabrously punctate, clothed with short pubescence; each elytron with four longitudinal costae, interrupted by two foveae.

Abdomen beneath densely punctate, lacking lateral callosities; last visible sternite broadly emarginate, lateral margin serrulate. Prosternum clothed with long pubescence, anterior margin with broadly rounded lobe. Anterior femur with acute tooth, lacking serration. Anterior tibia straight, lacking tooth near apex; other tibiae straight.

Length 9 mm.; width 3.4 mm.

Female.—Differing from male by entire head being brilliant cupreous; last visible abdominal sternite slightly bisinuate at apex.

Holotype labeled Phoenix, Ariz., May 9, 1925, R. H. Crandall collector; allotype May 25 of same year and collector, also paratypes from the same locality May 9 and 23. One from Sabino Canyon, Ariz.. May 11, 1938. F. H. Parker collector. Type material in collection of writer.

The species resembles *C. deserta* Horn and should probably stand next to it in Fisher's arrangement of the genus. Due to lack of tooth on the anterior tibia it can be distinguished from its allies.

BIOCHEMISTRY AND MORPHOGENESIS, by JOSEPH NEEDHAM, 1942. Pages xvi and 787, 328 text figs., 35 pls. Size 7x10 inches. Published by CAMBRIDGE UNIVERSITY PRESS, Cambridge, England, and THE MACMILLAN CO., 60 Fifth Ave., N. Y. Price $12.50.

This handsome volume summarizes all the facts of embryology as established in recent years by the research in the field of experimental embryology. Doctor Needham is an organic chemist (author of Chemical Embryology, 3 vols., 1931) as well as a student of embryology. This volume reflects his dual approach to the problem of morphogenesis. Spemann, the Mangolds, Paul Weiss, R. G. Harison and other experimentalists have described the functions of parts of the growing embryo with here and there light on the chemical background of the processes. Needham organizes such material scattered through many papers and volumes, adds to each process discussed his own work in the chemistry of the many processes and gives embryologists a broad organized view of the chemical processes involved in the developing embryo.

There are nineteen pages of indices. The volume is organized in three parts: Part I. The Morphogenetic Substratum; Part II. The Morphogenetic Stimuli; and Part III. The Morphogenetic Mechanisms. The three parts of the Table of Contents list six pages of subheads.

Doctor Needham is a lucid writer on intricately involved subjects. In this work he uses many illustrations and diagrams which help the reader keep oriented. But he has to deal with three dimensions, with macro-, micro- and chemical units. It becomes complex but is always interesting to the reader whose curiosity leads him into the processes and theories of embryonic development.

Biochemistry and Morphogenesis is as sound a volume as hard work and present knowledge of this field can produce. Apparently no part has suffered from hurried writing or has been glossed over. The reviewer found some basic facts about the insect egg that he had not picked up before in the scattered literature. We admire any man who can be so commanding in a biological field and so productive.—C. H. K.

THE ISOLATION OF A RED-FLUORESCENT PIGMENT, LAMPYRINE, FROM THE LAMPYRIDAE[1]

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The rose coloration of certain areas of the pronotal disc is a familiar taxonomic character of the coleopterous family, Lampyridae, and is mentioned in almost all descriptions of the adult members of this group. There are, however, no indications of the physical or chemical nature of this color. Observation of the pronotal pigment of *Photinus marginellus* with the fluorescent microscope showed that the pigment fluoresced a beautiful rose-red under the influence of ultra-violet irradiation. As red fluorescence is most infrequently encountered among biological materials, the material appeared to be of sufficient interest to warrant an investigation.

It was found that in *P. marginellus* the pigment appeared in the adipose tissue under the pronotum, and was spread subcutaneously through the meso- and meta-thoraces into the abdomen where it was encountered immediately beneath the cuticular layers of the dorsal abdominal wall. By far the greatest concentration, however, was in the male gonads, which were a deep rose, almost red color. When examined with the fluorescence microscope, the gonads presented a striking appearance. The yellowish tissue of these organs had an intense blue-violet fluorescence, through which was sprinkled tiny bright red fluorescent particles. Bugnion (1929) has confirmed the observation on the color of the male gonads in other genera. He states that the developing male gonads in *Lampyris*, *Phausis*, and *Pelania* are rose colored, in fresh tissue.

The male gonads are spheroidal bodies about 0.5 to 0.6 mm. in diameter and consist of a number of chambers or spermatic tubes, separated and surrounded by epithelial tissue, the whole being covered by a peritoneal sheath. Upon examination under high magnification, the color is seen to reside in very many tiny spherites, from 0.0007 to 0.003 mm. in diameter which are pinkish in color. The spherites are confined to the epithelial tissue under the peritoneal sheath of the testis. These spherites showed pronounced double refraction, with characteristic uniaxial interference figures, when examined with the polarizing microscope. The source of the pigment elsewhere in the insects' bodies was found in similar spherites imbedded in subcutaneous tissue.

When dried rapidly, the pigment apparently was very stable, appearing in the bodies of insects collected over 60 years ago, but in a moist state, the material was rapidly decomposed, probably by enzyme action. Dead insects that were left over night in a closed, moist bottle showed no trace of the pigment the next day. The pigment was very

[1]Contribution from the Division of Insect Physiology, Department of Entomology, Cornell University, Ithaca, N. Y.

insoluble in water, methyl and ethyl alcohols, ether, chloroform, carbon bisulfide, acetone, formaldehyde, pyridine, and acetic acid. It was soluble in 5% (and stronger) hydrochloric acid forming a faintly rose-colored solution which fluoresced in a bright orange band from 655 to 563 mu., with maxima at 635 and 600 mu. The addition of 30% potassium hydroxide solution to the pigment also dissolved it, turning it a dull blue, and shifting the fluorescence spectrum to a fiery red band, 672 to 622 mu., with a maximum at 650 mu., which faded slowly upon irradiation, to a yellow green. Ammonium hydroxide produced the same effect as potassium hydroxide, while concentrated nitric acid

TABLE I

Red Fluorescent Biochemical Substances, Showing Wave Lengths of Fluorescent Spectra[2]

Compound	Source	Solvent	Wave Length of Fluorescent Band in mu
lampyrine	*Photinus marginellus*	HCl	655–563
chlorophyll a	Green plants	Ethyl ether	680–650
chlorophyll b	" "	" "	655–640
chlorophyll c	" "	" "	637–627
protochlorophyll	" "	" "	633–620
bonelline	*Bonellia viridis*	Alcohol	681–666, 655–630, 617–607
pheophytin a	*Plant pigments*	Ether	747–713, 686–666
pheophorbides a	" "	Alcohol	Max. 730, 670
pheophorbides b	" "	"	Max. 725, 658
phylloerythrin	" "	Chloroform	650–636
phycoerythrin	" "	Water	585–572
phycocyanin	" "	"	653–642
protoporphyrin	Animals	HCl	663–647, 609–598
uroporphyrin	"	"	660–645, 601–592
coproprophyrin	"	"	659–645, 601–589
hematoporphyrin	"	"	654–646, 602–592
mesoporphyrin	"	"	657–642, 599–588
etioporphyrin	"	"	656–641, 598–589
porphine		"	Max. 648, 604
oxypenicilliopsine	*Penicilliopsis clavariaeformis*	Alcohol	649–635, 612–605, 599–590
hyperane	*Hypericum perforatum*	"	Similar to above.
lanigerine[3]	*Eriosoma lanigerum*	"	Max. 634, 608, 591, 561, 530, 499
strobinine[3]	*Pineus strobi*	"	Similar to above.

[2] Dhere, 1939a, with exception of lampyrine which is original observation.
[3] Dhere 1939 b.

completely destroyed the color and the fluorescence. Diazotization with nitrous acid had no effect on the color or fluorescence, nor did reduction with sodium hydrosulfite or oxidation with hydrogen peroxide. There was no color reaction with Ehrlich's diazo reagent, with aqueous ferric chloride, with the murexide test, and with reduction by zinc and hydrochloric acid.

The absorption spectrum of the material in dilute hydrochloric acid, showed a strong absorption band between the yellow and green at 565 mu.

By dissolving macerated gonadal tissue in 5% hydrochloric acid, warming gently, and allowing to cool gradually, tiny crystals, appar-

ently bipyrimidal, showing salmon pink fluorescence and double refraction with intense pleochroism were obtained. These melted at 315°C and presumably represented the pure compound. Although the gonads were dissected from more than 200 individual insects, the amount of pigment obtained was insufficient to permit a quantitative chemical analysis.

By a consideration of the previously known red fluorescent biological materials and their solubilities it becomes evident that the pigment differs widely from any hitherto described. (See Table I). As it is a red pigment it can scarcely be related to the chlorophylls and their derivatives which are green compounds and are ether and alcohol soluble. The porphyrins which possess similar absorption spectra, are soluble in organic solvents, have several fluorescent bands, and give characteristic color reactions with Ehrlich's diazo reagent. The polyhydroxyanthraquinones, which comprise a number of insect pigments, in the aphids and coccids, also have fluorescent spectra of more than one band and are alcohol soluble. In its solubilities, lampyrine somewhat resembles the acid and alkali soluble pterines, widely distributed pigments in the Lepidoptera. Schöpf and Becker (1936) have described several new fluorescent pterines: erythropterine, orange-red with brown fluorescence; xanthopterine, white with green-yellow fluorescence; and chrysopterine, orange with blue-violet fluorescence. These compounds, however, gave a definite murexide reaction, while lampyrine did not.

As the pigment is easily detectable in preserved specimens by examination under ultra-violet light, a survey of the Lampyridae and neighboring families was made to ascertain the distribution of the pigment throughout the family. Of 45 species examined in the collections of Cornell University and of the University of Illinois, the presence of the pigment was detected in 43. These are listed below:

Lucidota atra
L. tarda
L. punctata
Ellychnia flavicollis
E. facula
E. californica
E. corrusca
E. autumnalis
E. lacustris
Pyropyga fenestralis
P. nigricans
P. decipiens
P. minuta
P. indicta
Pyractomena angulata
P. galeata
P. borealis
P. ecostata
P. lucifera
P. angustata
Photinus consanguineus
Photinus lineellus
P. ardens
P. punctulatus
P. umbratus
P. dimissus
P. pyralis
P. vitattus
P. marginellus
P. dubiosus
P. scintillans
Pleotomus pallens
Photuris frontalis
Photuris divisa
Lampyris rufa
Aspidosoma buyssoni
Callopisma borencona
Microphotus angustus
Luciola parvula
L. vitticollis
L. mauritanica

No trace of the pigment could be found in *Tenaspis angularis*, of which a single specimen was examined, and in the common species *Photuris pennsylvanica*. It is quite possible that examination of fresh material of these two species would reveal the presence of the pigment, as it was occasionally not visible in certain specimens of species known to contain it, the postmortem treatment of the specimen apparently being an important factor. No trace of the pigment was found in a large number of species of the closely related families of Phengodidae, Cantharidae, or Lycidae.

In species where both males and females were at hand, *Photinus consanguineus* and *P. scintillans*, the pigment was abundant in both sexes. The pigment occurred plentifully in both luminous and non-luminous species and was apparently not a metabolite of the luminous processes.

The exceedingly wide and exclusive distribution of lampyrine in the Lampyridae would seem to indicate the presence of a peculiar type of metabolism, which is even more fundamental to the members of this singular group, than their well known property of luminescence. The author has no explanation to offer for the apparent formation of this material in the gonads, but feels that this subject offers an interesting field for future investigation.

SUMMARY

The isolation and crystallization of a pink, red fluorescent, acid and alkali soluble pigment, apparently new to science, is described. This material occurs, so far as is known, only in members of the coleopterous family Lampyridae, among which it is of wide distribution. It is apparently not closely identified with any of the known classes of insect pigments.

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SOME RESPONSES OF THE MALARIA MOSQUITO TO LIGHT[1]

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Methods of accurately sampling relative densities of species in local mosquito populations often trouble persons interested in mosquito abatement. With the present expansion of interest in reducing annoyance from mosquitoes in many widely distributed areas, evidence relating to the limitations of the methods is needed. At the present time, no one of the sampling devices alone is generally acceptable for accurately stating the quantitative relations of species in a local mosquito population, but those with light as the attracting principle have been widely used in the United States.

In recent years, the New Jersey style light trap (8) has been standardized in construction and has been in use in different parts of the country (5, 7, 9, 3). This device has proved useful as a means of comparing trap collections of pest species and relative human annoyance in New Jersey (2) where the longest continuous series of collections has been made. As a means of sampling relative populations of species, this trap has been criticized by some observers; for example, its dependability is considered uncertain in situations where anophelines are present according to Herms and Gray (4). These writers say there are still too many unknown factors affecting the reactions of mosquitoes to light and other stimuli to place much confidence in either the qualitative or quantitative aspects of the catches.

A New Jersey trap with minor modifications has been operated at the Rice Branch Experiment Station in the rice region of Arkansas where large populations of mosquitoes occur. The attracting element was a 40-watt, frosted, mazda, electric bulb operating on a 110-volt, alternating-current circuit. The trap was suspended so that the light radiated in all horizontal directions from an elevation of 5½ feet above the ground. There were no adjacent competitive lights. A part of the time it was operated in conjunction with an apparatus for automatically changing the collecting jars at hourly intervals (6). Three years of collecting show certain consistent responses of the malaria mosquito to light.

The mosquito population in the region is composed of both floodwater (*Psorophora*) and permanent-water (*Anopheles* and *Culex*) species. The *Psorophora* emerge from a rice field during a short interval beginning within a few days after flooding (5), and the relative numbers trapped during any one night are determined for the most part by the acreage being flooded and by the proximity of that acreage to the trap. To a lesser degree, direction and speed of the air drift determine the numbers trapped. Records on these species show nightly fluctuations sometimes

[1]Research Paper No. 752, Journal Series, University of Arkansas. Approved for publication by the Director of the Arkansas Agricultural Experiment Station.

TABLE I

Relation Between Phase of Moon and Hourly Attraction of *Anopheles quadrimaculatus* to Light at the Rice Branch Experiment Station

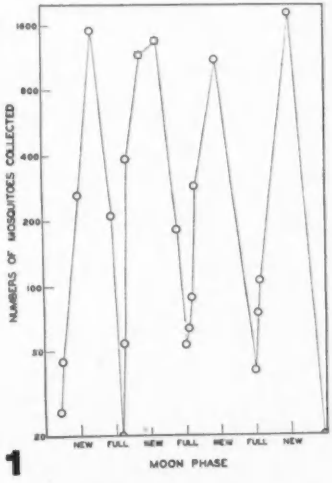
1939—1941

Hour	Collections of Mosquitoes at Time of New Moon					Collections of Mosquitoes at Time of First Quarter		Collections of Mosquitoes at Time of Full Moon					Collections of Mosquitoes at Time of Last Quarter			
	1939	1940	1941	Total* 3 yrs.	Per Cent	1941	Per Cent**	1939	1940	1941	Total* 3 yrs.	Per Cent	1940	1941	Total*** 2 yrs.	Per Cent
	Number	Number	Number	Number		Number		Number	Number	Number	Number		Number	Number	Number	
8	20	5	71	96	1	7	.....	6	2	.....	8	4	21	12	33	4
9	201	30	264	495	7	58	4	25	3	4	32	15	46	45	91	13
10	132	37	404	573	7	64	4	35	1	8	44	21	40	51	91	13
11	242	49	888	1179	15	165	11	18	.....	4	22	11	44	40	84	12
12	262	99	514	875	11	234	16	12	2	4	18	9	42	78	120	17
1	421	91	482	994	13	314	22	7	1	3	11	5	44	94	138	19
2	443	68	672	1183	15	360	25	22	1	11	34	16	22	51	73	10
3	770	72	754	1596	20	175	12	8	1	4	13	6	17	38	55	7
4	264	49	502	815	10	67	5	10	5	4	19	9	9	15	24	3
5	8	6	80	94	1	10	1	5	.....	2	7	3	2	13	15	2
Total.....	2763	506	4631	7900	.....	1454	.....	148	16	44	208	.....	287	437	724	.....

* 9 observations.
** 3 observations.
*** 6 observations.

of extreme proportions because of temporarily heavy flights from nearby sources. *Anopheles quadrimaculatus* Say, on the other hand, emerges continuously and fairly uniformly all summer from all flooded fields (5), and enough flooded fields may be found in the vicinity of a trap to provide a nearly constant population.

In spite of its constant source, the anopheline shows certain cyclic variations in relative numbers collected in light traps (figs. 1 and 2). Trapping results during two seasons, when large numbers were collected, show four peak periods during one summer (1939) and three during the



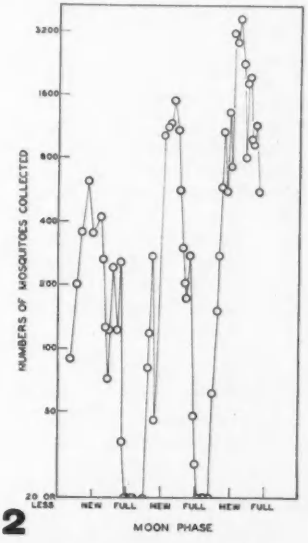


Fig. 1. Relation between lunar cycles and collections of female *Anopheles quadrimaculatus* at light at the Rice Branch Experimental Station, 1939.

Fig. 2. Relation between lunar cycles and collections of female *Anopheles quadrimaculatus* at light at the Rice Branch Experiment Station, 1941.

other (1941). A fourth peak undoubtedly would have been indicated in 1941 had the trapping season been extended as long as in the previous season. The periods of maximum collection occurred at about monthly intervals and alternated with periods when relatively few specimens were collected (figs. 1 and 2).

The cyclic rise and fall in numbers of *Anopheles* collected in light traps coincided with the lunar cycles during the same interval. As the moon waxed, the numbers declined until hardly any were collected on or near nights when the moon was full. Conversely, as the moon waned, collections increased and reached a peak near or shortly after the appearance of the new moon.

A cyclic variation in collections of the malaria mosquito coinciding with lunar variations is indicated in the results obtained by Carpenter at Camp Robinson in 1941 (1). His graphic representation of average weekly trapping records throughout the season show four peak periods of abundance and four depressions. If the lunar phases are plotted on the graph, the peak periods of abundance coincide closely with the appearance of the new moon, and the depressions appear with the light of the moon.

Collections of the malaria mosquito made at hourly intervals during the night show that this species enters a trap in greatest numbers at different times in accordance with lunar variations (see Table I). During those nights near the time in the lunar cycle when the moon was new, three-fourths of the mosquitoes were collected between 11 and 3 o'clock. Three-fourths of the mosquitoes were collected between 12 and 3 o'clock during nights when the moon set at midnight. When the moon was full, three-fourths of the mosquitoes collected came to the trap between 9 and 2 o'clock. When the moon began the last quarter and therefore appeared after midnight, three-fourths of the mosquitoes came to the trap between 9 and 1 o'clock. The total collections made during the nights near the new moon had the greatest numbers. Next most numerous were those in the collections made during the nights when the moon entered the first quarter. Third, numerically, were the collections made at the time of the last quarter. During nights at or near full moon almost no *Anopheles* were collected.

SUMMARY AND CONCLUSIONS

In the rice region of Arkansas, the mosquito population is composed of (1) species which vary greatly in numbers in the region of a light trap because their sources vary and (2) other species that are fairly constant numerically because their sources are not greatly variable. Under these conditions, population comparisons based on total summer collections may be inaccurate.

Malaria mosquitoes, even though their source is fairly uniform, are attracted to light traps in varying numbers as changes occur in the lunar cycle. When the moon is full or nearly so, the numbers attracted to light ebb; and when the moon is new, they are attracted in greatest numbers. The trap light is more or less effective in proportion to the intensity of the light from the moon. The darker the night, the greater the area over which the trap light exerts its attractiveness, and consequently the greater the numbers of mosquitoes attracted, other things being equal.

Malaria mosquitoes are attracted to a light trap most abundantly near and after midnight. During nights at or near the time of the new moon, this is most clearly evident. When the moon sets at midnight, most mosquitoes are attracted after midnight, and when the moon rises at midnight most mosquitoes are attracted before the moon rises. During nights when the moon is full, the attraction is not noticeably different before and after midnight.

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MEDICAL DISEASES IN TROPICAL AND SUB-TROPICAL AREAS. 282 pp., 108 figures. First American Edition. Size 8¾x5¾ inches. Published by the CHEMICAL PUBLISHING CO., INC., 234 King Street, Brooklyn, N. Y. Price $4.75, clothbound.

This is the first time in our experience of reviewing books that a systematic search of the volume in hand fails to indicate the author or authors. The name, W. P. MacArthur, Lieutenant-General, Director General Army Medical Services, follows the preface and we assume that under his direction various authors have made a compilation. It seems further that this is the sixth edition of a British manual and it has been reprinted in the United States by permission of the Controller of His Brittanic Majesty's Stationery Office.

The list of contents is: Ancylostomiasis; Arthropod Pests; Beriberi; Blackwater Fever; Cerebro-Spinal Fever; Cholera; Cysticercosis; Dengue; Diarrhoea; Dysentery; Dysentery, Amoebic; Dysentery, Baccilary; Filariasis; Heat-Stroke; Hepatic Abscess; Jaundice; Leishmaniasis (Kala-Azar); Leptospirosis Icterohaemorrhagica; Malaria; Myiasis; Oriental Sore; Paratyphoid Fever; Phlebotomus Fever; Plague; Relapsing Fever, including Tick Fever; Schistosomiasis; Scurvy; Skin Diseases; Sleeping Sickness; Small-Pox; Sprue; Trench Fever; Typhoid Fever; Typhus Fever; Undulant Fever; Yellow Fever; Appendix (Zoological Nomenclature); Index. These subjects are handled in a concise manner. Recent discoveries are included. The entomological aspects of tropical medicine are evident in the chapter titles and additional comment is unnecessary.

The appearance of this handbook of essentials now is appropriate when United States troops are entering tropical regions and accompanying physicians and sanitary officers are encountering problems which are new to them. Teachers and students, whether in medicine or entomology, should get acquainted with this subject while still at home. Our military organization is making much use of entomologists and it is the duty of these men to be informed.—C. E. VENARD.

DESCRIPTION OF FEMALE AMPULEX (RHINOPSIS) FERRUGINEA BRADLEY

(Hymenoptera; Ampulicidae)

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Ampulex ferruginea was described by Bradley in 1934 (Ent. News, 45: 273, 1936) from a single male taken at Liberty, Texas. (Mar. 18, 1908, by E. G. Tucker). This is the only published record of the species and since the female has never been described it seems worth while to present the following description and collection data.

Length 9 mm. Ferruginous throughout except abdomen which is polished black. Wings infuscated apically.

Head.—Ferruginous, flattened dorso-ventrally, as wide as mesothorax. Eyes large, black; the posterior facets much smaller than the anterior; inner margins parallel, only very slightly concave. Ocelli three, distinct, forming a small, equilateral triangle with possibly the two upper nearer each other than to the anterior; they lie below a line drawn between the posterior margins of the compound eyes; anterior ocellus with a slight transverse impression below it. In some lights the lateral ocelli each have a slight impression on the outer side.

Frons and occiput distinctly and uniformly punctate. Cheeks and ventral surface not quite so distinctly punctate and more polished. A distinct ventral carina from base of head to that surrounding the buccal orifice. A weak tubercle on each side of head ventrally near the base.

Antennae slender, reaching a little beyond wing bases; minutely pubescent; inserted at the base of the clypeus, below the anterior margin of the eye. Scape ferruginous; pedicel and flagellum uniform color throughout, darker than the scape. A rather large, deep depression behind the insertion of the antennae. A frontal lobe overlies base of antennae, leading upward into a short carina. First joint of flagellum longer than the next two joints combined.

Clypeus, long, narrow, nose-like in appearance. Three prominent teeth on anterior margin; two less distinct ones laterally. Several pale, bristle-like setae project outward and downward from the lateral and anterior margins. Without carina or transverse median impression.

Lingual palpi four-jointed, the fourth being a long bristle. Maxillary palpi five-jointed.

Mandibles long, rather straight with the tips turning in rather sharply. Edentate. Somewhat flattened, with the inner margins thin and scythe-like. Base of the mandibles touching the eye; quite distant from the buccal orifice.

Thorax.—Prothorax as long as the mesothorax, little more than half as wide. Neck distinct, long. The prothorax rises abruptly from the neck, forming a raised portion narrower than the ventral part. This raised portion has a strong median sulcus which gradually disappears posteriorly; rugosely punctate dorsally on either side of the sulcus. Sides smooth and shining. A carina laterally from base of

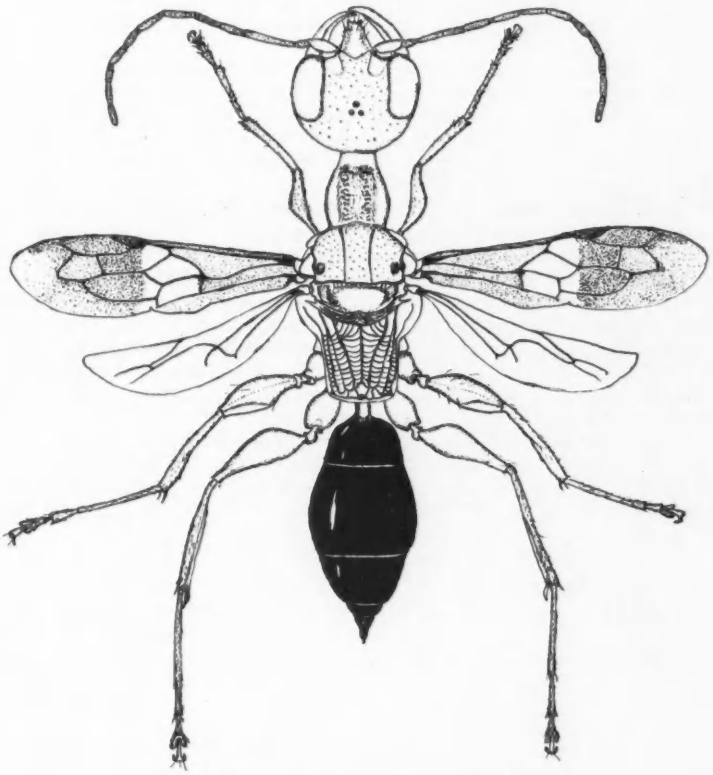

Fig. 1. Female *Ampulex ferruginea* Bradley.

head to anterior coxa and another on the mid-ventral line. Distinctly punctate ventrally. Prothoracic lobes extend laterally onto the anterior face of the mesothorax, quite distant from sclerite of fore wing. A distinct constriction between pro- and mesothorax.

Mesothorax punctate throughout. Mesonotum with parallel parapsidal furrows. A deep angular depression above wing base. The mesonotal laminae are black. A carina from below prothoracic

lobe runs obliquely backward and downward to join the longitudinal sulcus which separates the mesosternum from the pleura. The prepectal carina is distinct below the wing, disappears shortly and again becomes distinct just before it runs into the carina from the prothoracic lobe. Infuscated below, especially along the mid-ventral line. A transparent, bifurcated process projects backward from the mesosternum with one prong lying on the base of each posterior coxa.

Scutellum smooth above, deeply depressed laterally.

Postscutellum, narrow, silvery pubescent. Metapleurae smooth and shining.

Propodeum quadrangular. Nine dorsal longitudinal carinae which converge toward the apex and with numerous transverse carinae between them. A short spine on the posterior dorso-lateral angle. Sides smooth and shining anteriorly, rugose posteriorly. Posterior face slightly rounded, rugose; a silver pubescent spot above base of petiole.

Abdomen.—Petiole ferruginous, rest of the abdomen black, polished, shining, impunctate. Brownish tinge on the margins of all but the first segment. Ventrally the abdomen is convex with numerous pale small hairs visible in certain lights. A few pale hairs dorsally on the posterior segments.

Legs.—Fore legs without tarsal comb. Middle legs with two tibial spurs. Hind tibia with a line of golden pubescence on the inner face, ending in a spot of golden pubescence at the apex. All coxae large and free; hind coxae with silvery pubescence above. All femora somewhat swollen near the middle.

Wings.—Stigma large, dark; marginal cell appendiculate; two submarginal cells. Abruptly infuscated from a line drawn transversely through the wing from base of stigma, but gradually disappearing near the apex. Lightly infuscated from wing base to basal vein. The central part of the wing is hyaline.

Hind wing hyaline, with two closed cells.

This differs from Bradley's description of the male as follows: Clypeus has three apical teeth, only one in the male; no malar space, very short in the male; no pit behind posterior ocelli, present in the male; abdomen black, piceous in the male; thorax more punctate than male.

The above description is based on a single female taken June 11, 1939, in Hunt County, Texas, near Commerce. The insect is in the collection of the writer.

The fore legs and mandibles are not adapted for digging so it very likely stores its prey in hollow twigs as does *A. canaliculatus.*

This species can be easily distinguished from *A. canaliculatus* by the color of the head and thorax which is ferruginous in ***ferruginea*** and black in *canaliculatus.*

THE AMERICAN BEES OF THE GENUS ANTHOCOPA WITH NOTES ON OLD WORLD SUBGENERA

(Hymenoptera, Megachilidae)

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In a recent paper on the American genera of Osmiinae[2] the name *Anthocopa* was used for a large number of species related to *Osmia* and *Hoplitis*. The species there included in *Anthocopa* have, for the most part, been placed in *Osmia* by previous authors. They differ from *Osmia* and resemble *Hoplitis*, however, in the linear rather than punctiform notauli. *Anthocopa* is, indeed, very closely related to *Hoplitis*. Although the two genera are easily separated in the western hemisphere, certain Eurasian groups are practically intermediate, and their placement in one genus or the other is more or less arbitrary.

Since considerable space has been devoted to outlining the generic characters in the paper already referred to, it will suffice to state here that *Anthocopa* may be distinguished from *Hoplitis* by the robust, *Osmia*-like form, with the anterior face of the first tergite longer than the dorsal face and separated from it by a line or carina, and commonly by the presence of a carina along the inner ventral angle of each posterior coxa. American species of *Anthocopa* agree in certain characters used to distinguish various Old World subgenera. Thus females of all our species have the clypeus produced well over the base of the labrum. Antennae of the males in our species are simple, and except in *A. xerophila* they are as short (or nearly as short) as those of the females.

A brief historical review of the American species of the genus is of interest because it gives an indication of the richness of the western bee fauna, which has only recently received any considerable study. Our first species of this genus was described in 1878 by Cresson, and the next by Cockerell in 1908. A third was described by Cockerell in 1930, fourteen more by the same author in 1935, two by Michener in 1936, and eight additional species and one subspecies are made known in the present paper.

DISTRIBUTION AND PHYLOGENY

All known American *Anthocopa* are found in the western United States, the easternmost records being at the eastern foot of the Rocky

[1]I wish to thank Mr. G. E. Bohart, Dr. R. M. Bohart, Mr. U. N. Lanham, Dr. E. G. Linsley, Mr. J. W. MacSwain, Dr. E. S. Ross, Dr. H. A. Scullen, the late Mr. E. P. Van Duzee, and especially Mr. P. H. Timberlake for the opportunity to study specimens from their own collections or from the collections of which they are in charge. Furthermore, for numerous courtesies and much helpful advice, I express my gratitude to Dr. Linsley and Prof. E. O. Essig.

This paper was prepared at the University of California, Berkeley, California.

[2]Michener, C. D., 1941, A generic revision of the American *Osmiinae* with descriptive notes on Old World genera. Amer. Midl. Nat., 26: 147–167, 21 figs.

Mountains. The subgenera *Atoposmia* and *Hexosmia* are montane and northern groups rather common in the high mountains of California, and occurring on the high ranges of the Great Basin and in the Rocky Mountains of Colorado. The center of abundance, both of individuals and of species, for both of these subgenera is in California, and for *Atoposmia* it appears rather clearly to be on the high, arid slopes of the mountain ranges facing the Great Basin. *Atoposmia* is rather clearly related to the Eurasian subgenera *Anthocopa* s. str. and *Glossosmia*.

The other American subgenera, *Eremosmia*, *Xerosmia* and *Phaeosmia*, are groups largely confined to the desert immediately east of the mountains which separate the Great Basin and Colorado Desert areas from the moister coastal regions. That is, they occur in the western part of the Great Basin and Colorado Desert regions. They have not yet been found outside of California. Indeed most of the specimens of these subgenera which have thus far been collected come from points within easy view of the mountains which form the western boundaries of the desert areas.

It is interesting to note that the area in which these desert subgenera occur is precisely the region in which the species of *Ashmeadiella* are most abundant and diversified. It seems likely, as suggested in the paper on *Ashmeadiella*[3], that these groups [there mentioned as derivatives of *Osmia*, (a generic name there used in a broad sense)] originated in a manner comparable to *Ashmeadiella*, but probably at a considerably later time, as shown by their limited distribution and diversification. In all probability, montane types, upon coming in contact with adjacent desert areas, gave rise to the desert subgenera. To judge from the close relationship to *Hoplitis* shown by some Palearctic forms, and the large number and great diversity of species of that region, Eurasia is the area in which *Anthocopa* (as well as *Hoplitis*) originated.

At least two distinct types of *Anthocopa* have entered the Nearctic region from the Palearctic. One of these apparently gave rise to *Atoposmia* and *Eremosmia*, the other to *Hexosmia* and *Phaeosmia*, probably to *Xerosmia* and perhaps to the genus *Ashmeadiella*.

HABITS

Very little is known of the nesting habits of American species of *Anthocopa*. Numerous specimens of *A. xerophila* were reared (by Mr. J. W. MacSwain) from old nests of *Anthophora linsleyi* Timberlake (collected by Mr. G. E. Bohart).

The flower visiting habits, however, are comparatively well known and are clearly correlated with the structural characters upon which the subgenera are based. Thus *Xerosmia* apparently collects pollen only from *Cryptantha*, *Phaeosmia* from the Compositae, *Hexosmia* from from Hydrophyllaceae such as *Phacelia* and *Nemophila*, and *Eremosmia* from both Leguminosae and Hydrophyllaceae. The pollen collecting activities of *Atoposmia* are almost entirely limited to *Pentstemon*.

The subsequent part of this paper is divided into two sections, the first dealing with American subgenera and species, and the second dealing with Old World subgenera.

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[3]Michener, C. D., 1939, A revision of the genus Ashmeadiella, Amer. Midland Nat., 22: 1–84.

PART I

AMERICAN SUBGENERA AND SPECIES OF ANTHOCOPA

KEY TO THE AMERICAN SUBGENERA OF ANTHOCOPA

MALES

1. Mandibles tridentate....2
   Mandibles bidentate....3
2. Trophi long, when folded reaching well behind anterior coxae; posterior coxae with carina along inner ventral angle feeble (p. 51)....**Atoposmia**
   Trophi short, when folded hardly reaching fore coxae; posterior coxae each with a conspicuous carina along inner, ventral angle (p. 66)....**Eremosmia**
3. Maxillary galeae and labial palpi furnished with stiff hairs with hooked apices; seventh tergum largely exposed, with a large transverse sulcus medially and three long teeth apically (p. 81)....**Xerosmia**
   Maxillary galeae and labial palpi without hooked hairs; seventh tergum but little if at all exposed, not tridentate....4
4. Posterior coxae each with strong longitudinal carina on inner ventral angle; clypeal truncation much longer than distance from its end to lateral angle of clypeus; black, without metallic luster (p. 77)....**Phaeosmia**
   Posterior coxae with inner ventral carinae feeble; clypeal truncation concave and shorter than distance from its end to lateral angle of clypeus; body with feeble metallic luster (p. 74)....**Hexosmia**

FEMALES

1. Maxillary galeae and first two segments of labial palpi furnished with stiff hairs with hooked apices (p. 81)....**Xerosmia**
   Maxillary galeae and labial palpi without hooked hairs....2
   (See *A. palmarum* (Cockerell), the trophi of the type of which have not been examined.)
2. Trophi long, when folded reaching well behind anterior coxae; posterior coxae with carina along inner ventral angle feeble (p. 51)....**Atoposmia**
   Trophi short, when folded hardly reaching anterior coxae; posterior coxae with carinae along inner ventral angles variable in strength....3
3. Body with a feeble metallic green luster; posterior coxae with inner ventral carinae weak (p. 74)....**Hexosmia**
   Body black, without metallic luster; posterior coxae each with a strong carina on inner ventral angle....4
4. Mandibles more than four times as long as shortest breadth (length measured from apex to lower basal angle) (p. 66)....**Eremosmia**
   Mandibles less than four times as long as greatest breadth (p. 77)....**Phaeosmia**

Subgenus **Atoposmia** Cockerell

Atoposmia COCKERELL, 1935, Pan-Pac. Ent. 11: 50. MICHENER, 1936, Can. Ent., 68: 41.

Type species: *Osmia triodonta*, Cockerell, by original designation.

Black without metallic tints. Eyes with inner margins subparallel in male, slightly converging below in female; mandibles of male tridentate, of female tridentate or with inner subapical angle produced distally to form a fourth tooth; mandibles of female sometimes slender, over four times as long (measured from lower basal angle to apex) as shortest breadth, in other species much more robust, less than three times as long as shortest breadth; trophi much elongated, first segment of labial palpi less than one-fourth as long as second. Longitudinal carina of inner ventral angle of each posterior coxa weak or nearly absent. Second sternum of male considerably

enlarged, its posterior margin broadly rounded, third sternum usually emarginate posteriorly, the emargination fringed; sixth tergum toothed or angulate laterally, seventh exposed apically and normally with a pair of apical lobes between which stands a tooth (either the lobes or the tooth may be reduced).

This is primarily a montane subgenus of the western United States, confined almost entirely in its flower visiting habits to species of *Pentstemon*.

KEY TO THE SPECIES OF ATOPOSMIA

Females

1. Mandibles quadridentate as a result of the distad production of the subapical dorsal swelling; apex of clypeus with a small, deep, median emargination between a pair of submedian teeth (p. 65) ..... **panamintensis**
   Mandibles tridentate; apex of clypeus simple or slightly sinuate 2
2. Maxillary palpi shorter than first segment of labial palpi, apparently four-segmented; mandibles about three times as long as shortest width (p. 64), **pycnognatha**
   Maxillary palpi about equal in length to first segment of labial palpi, five-segmented; mandibles at least slightly more than three times as long as shortest width 3
3. Cheeks finely and densely punctate, more finely so above than middle of vertex, and furnished with numerous rather short, depressed, anteriorly directed hairs (which are inconspicuous if dark in color); clypeus closely punctate, punctures about as fine as those of frons 4
   Cheeks as coarsely or more coarsely punctate than vertex, punctures not dense, pubescence sparse and less depressed than in above; clypeus usually more coarsely and less closely punctate than frons 5
4. Scopa yellowish white (p. 62) ..... **triodonta**
   Scopa ferruginous, sometimes blackish laterally and posteriorly (p. 64), **shastensis**
5. Scopa black or reddish black; abdominal terga with much black pubescence ... 6
   Scopa and abdominal pubescence white 7
6. Disc of mesoscutum with punctures widely separated and smaller than those of rest of scutum or of vertex (p. 57) ..... **abjecta**
   Disc of mesoscutum with punctures less widely separated, larger than those of rest of scutum or of most parts of vertex (p. 54) ..... **nigrior**
7. Abdominal scopa short, that of second sternum little if at all longer than greatest length of exposed portion of second tergum (p. 53) ..... **oregona**
   Abdominal scopa long, especially anteriorly, that of second sternum markedly longer than greatest length of second tergum 8
8. Notch between first and second mandibular teeth prolonged into a deep narrow sinus (as in fig. 1); subapical dorsal swelling of mandible distant from apex of third tooth by distance equal to or scarcely less than shortest width of mandible (p. 60) ..... **anthodyta**
   Notch between first and second mandibular teeth simple, acute but not prolonged into a narrow sinus; subapical dorsal swelling distant from third tooth by distance equal to little if any over one-half shortest width of mandible 9
9. Inner hind tibial spur practically straight (p. 61) ..... **elongata**
   Inner hind tibial spur bent apically (p. 57) ..... **alta**

Males

1. Posterior margin of third abdominal sternum with a but feebly emarginate, fringed median section (p. 65) ..... **panamintensis**
   Posterior margin of third abdominal sternum with a more or less strong emargination, if shallow, made conspicuous by the fringe which is long laterally so that the apical margin of the fringe is strongly emarginate 2
2. Maxillary palpi apparently four-segmented, much shorter than first segment of labial palpi; lateral margins of sixth tergum convex (p. 64) ... **pycnognatha**

Maxillary palpi five-segmented, fully as long as first segment of labial palpi; lateral margins of sixth tergum usually but feebly convex or slightly sinnate....3

3. Truncation of clypeus slightly produced, but little longer than distance from end of truncation to lateral angle of clypeus (p. 61)....**elongata**
Truncation of clypeus not produced, usually over three times as long as distance from end of truncation to lateral angle of clypeus....4

4. Seventh tergum with lateral lobes exceeding median tooth....5
Seventh tergum with median tooth exceeding lateral lobes....8

5. Second tergum with punctures of median portion of dorsum minute and separated by many times their diameters....6
Second tergum with punctures of median portion of dorsum larger and separated at most by four or five times their diameters (p. 62)....**triodonta**

6. Impunctate margin of clypeal truncation rather broad....7
Impunctate margin of clypeal truncation exceedingly narrow (p. 64), **shastensis**

7. Distance between posterior ocelli less than distance from one of them to eye margin (p. 57)....**alta**
Distance between posterior ocelli equal to distance from one of them to eye margin (p. 59)....**mesae**

8. Lateral margins of sixth tergum strongly convex; abdomen with fuscous and blackish hairs, especially laterally (p. 54)....**nigrior**
Lateral margins of sixth tergum straight or nearly so; abdominal pubescence pale....9

9. Mandibles with inner apical angle right angular (p. 53)....**oregona**
Mandibles with inner apical angle acute (appearing right angular in certain views) (p. 60)....**anthodyta**

Anthocopa (Atoposmia) oregona, n. sp.

(Fig. 23)

This is a moderate sized, rather slender species. It resembles ***panamintensis*** in having a short, white scopa in the female, but differs from that species in the tridentate mandibles. This species resembles ***nigrior*** except for the black pubescence, but differs from that species in the straight lateral margins of the sixth tergum of the male, the more acute second mandibular tooth of the female, etc.

Female.—Length 8½ mm. (varying to 7 mm. among paratypes). Pubescence dull white. Punctures of head rather coarse, dense on the frons but elsewhere conspicuously separated, those of clypeus larger than those of frons or vertex; anterior ocellus farther from antennal bases than from posterior edge of vertex; distance between posterior ocelli equal to distance to eye margin, greater than distance to posterior edge of vertex; pubescence of cheeks sparse, suberect; clypeus with a longitudinal median raised, impunctate line (rarely inconspicuous), truncation slightly emarginate medially, broadly rounded at ends; mandibles nearly four times as long as shortest breadth, tridentate, notch between first and second teeth not deepened into a sinus, third tooth with inner margin parallel to long axis of mandible so that the tooth is strongly acute, subapical inner swelling distad from third tooth (from paratype) by distance equal to about two-thirds of shortest width of mandible; maxillary palpi (from paratype) five-segmented, about as long as first segment of labial palpi, third segment much the longest. Thorax with punctures for the most part about as large as largest on vertex, and in most areas separated by about half their diameters or less, but those of

center of disc of mesoscutum and of mesepisternum separated by their diameters or more, and with a few minute punctures among them; enclosure of propodeum hardly roughened above medially; inner hind tibial spurs slightly curved apically. Abdomen rather finely punctate, punctures of median part of second tergum separated by more than their diameters; scopa white, longest hairs of second sternum shorter than length of exposed portion of second tergum; apical pubescent bands of terga feeble and broadly broken medially.

Male.—Length 7½ mm. Similar to female in appearance and punctation; punctures of clypeus a little finer than in female, but not fine and close as in many males; truncation of clypeus over three times as long as distance from its end to lateral angle of clypeus, margin of truncation coarsely and rather irregularly crenulate, rather broadly impuncatate. Third abdominal sternum with a conspicuous fringed emargination; sixth tergum with a tooth ending in a right angle (sometimes reduced to a feeble bend in the margin) at each side; lateral margins of sixth tergum somewhat sinuate, convex toward the rear; seventh tergum with median apical tooth, but lateral lobes reduced to rounded shoulders (in some lateral lobes better developed, but shorter than median tooth).

Holotype female (Calif. Acad. Sci. Ent. No. 5168), allotype male (Calif. Acad. Sci., Ent. No. 5169), and four paratypes: McKenzie Pass, Oregon, 5000 feet elevation, July 18, 1927 (H. A. Scullen); one female paratype, Cloud Cap, Crater Lake, Oregon, 7500 feet elevation, August 2, 1930, on *Pentstemon* (H. A. Scullen); three female paratypes, Mt. Hilman, Crater Lake, 7500 to 8000 feet elevation, July 31, 1930 (H. A. Scullen).

I am indebted to Dr. H. A. Scullen for the opportunity to study this species, as well as for permission to place the types in the collection of the California Academy of Sciences. Paratypes will be found in the Oregon State College collection, and in that of the author.

Anthocopa (Atoposmia) nigrior, n. sp.

(Fig. 28)

This is a moderate sized, rather slender species distinguished from others except *abjecta* by the partly fuscous and black pubescence and black scopa of the female and fuscous and blackish pubescence on the abdomen of the male. The scopa of the female is longer than in *oregona*, shorter than in species such as *alta*. It differs from *abjecta* by the coarsely

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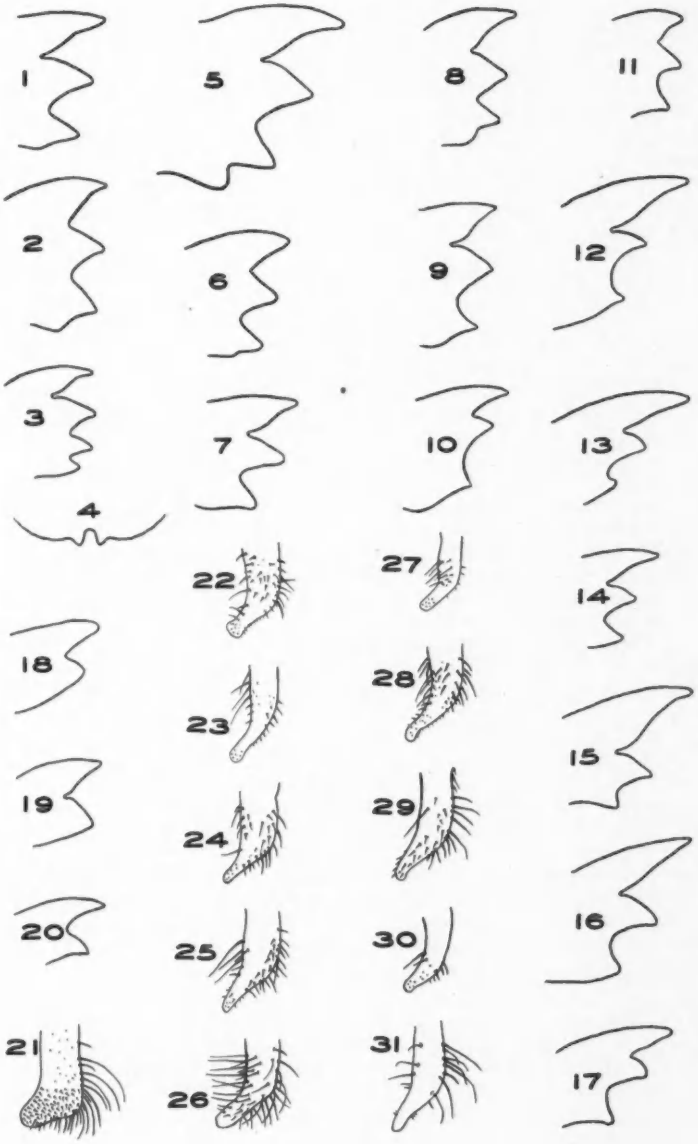
EXPLANATION OF PLATE

Apices of mandibles of: 1, *Anthocopa anthodyta*, ♀; 2, *A. triodonta triodonta*, ♀; 3, *A. panamintensis*, ♀; 4, margin of clypeus of *A. panamintensis*, ♀.

Apices of mandibles of: 5, *A. robustula*, ♀; 6, *A. nitidivitta*, ♀; 7, *A. rupestris*, ♀; 8, *A. mortua*, ♀; 9, *A. enceliae*, ♀; 10, *A. laevibullata*, ♀; 11, *A. copelandica*, ♀; 12, *A. triodonta triodonta*, ♂; 13, *A. anthodyta*, ♂; 14, *A. panamintensis*, ♂; 15, *A. robustula*, ♂; 16, *A. nitidivitta*, ♂; 17, *A. rupestris*, ♂; 18, *A. mortua*, ♂; 19, *A. enceliae*, ♂; 20, *A. copelandica*, ♂.

Apices of male gonopods of: 21, *A. xerophila;* 22, *A. anthodyta;* 23, *A. oregona;* 24, *A. panamintensis;* 25, *A. triodonta triodonta;* 26, *A. nitidivitta;* 27, *A. elongata;* 28, *A. nigrior;* 29, *A. pycnognatha;* 30, *A. robustula;* 31, *A. rupestris.*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punctate disc of the mesoscutum, coarser punctures of the head, slightly different mandibular structure, etc.

Female.—Length 8 mm. (to 10 mm. in paratypes). Pubescence of head grayish white with black hairs intermixed on frons and vertex, that of clypeus almost entirely black; punctures of head not very dense, but separated for the most part by much less than half their diameters, those of clypeus dense, slightly coarser than those of frons and vertex and arranged in longitudinal rows; anterior ocellus farther from antennal bases than from posterior edge of vertex; distance between posterior ocelli equal to distance from one of them to eye margin, greater than distance to posterior edge of vertex; pubescence of cheeks sparse, suberect; clypeal truncation rounded at ends, somewhat emarginate medially, but little shorter than distance from end to lateral angle of clypeus; mandibles but little more than three times as long (measured from ventral, basal angle) as shortest width, tridentate, notch between first and second teeth not deepened as a narrow sinus, subapical inner swelling distant from apex of third tooth by distance equal to over half of shortest width of mandible. Thorax with pubescence grayish white; punctation of mesoscutum similar to more coarsely punctured portions of vertex, punctures of discal area more widely separated; punctures of mesepisterna coarser, separated by much less than their diameters; enclosure of propodeum broadly roughened above; pubescence of legs black or dusky, inner hind tibial spurs curved apically. Abdomen rather strongly punctured, punctures of middle of second tergum separated, for the most part, by two or three times their diameters; scopa black; pubescence of abdominal terga black or dusky, except for white hairs at the posterior margins laterally.

Male.—Length 9 mm.; similar to female in appearance. Pubescence white, that of abdomen intermixed especially laterally with fuscous and black. Punctation of clypeus finer and closer than that of rest of head; distance between posterior ocelli greater than distance to posterior edge of vertex which is greater than distance to eye margin; clypeal truncation more than three times as long as distance from its end to lateral angle of clypeus, margin of truncation feebly crenulate and narrowly impunctate; maxillary palpi five-segmented, as long as first segment of labial palpi, third segment much the longest, second next longest. Third abdominal sternum with a broad fringed emargination in posterior margin; sixth tergum with a tooth at each side ending in a somewhat obtuse angle, lateral margins of sixth tergum convex; seventh tergum with a broad median tooth with a rounded apex, lateral lobes reduced to rounded shoulders.

Holotype female (Calif. Acad. Sci., Ent. No. 5170): Onion Creek Meadows, Grant County, Oregon, 7700 feet elevation, July 18, 1936 (R. E. Rieder). Allotype male: (Calif. Acad. Sci., Ent. No. 5171): Hermiston, Oregon, May 10, 1930 (H. A. Scullen). Two female paratypes: Wallowa, Wallowa County, Oregon, June 27, 1936, on thistle (I. McCracken).

As in the case of the preceding species, permission to place the types in the collection of the California Academy of Sciences was kindly granted by Dr. H. A. Scullen.

Anthocopa (Atoposmia) abjecta (Cresson)

Osmia abjecta Cresson, 1878, Trans. Am. Ent. Soc., 7: 103; Cockerell, 1906, Bull. Am. Mus. Nat. Hist., 22: 446; Friese, 1911, Das Tierreich, 28: 144; Cockerell, 1928, Univ. Colorado Studies, 16: 124, 125; Cockerell, 1932, Bull. Brooklyn Ent. Soc., 27: 204; Michener, 1936, Can. Ent. 68: 41.
Hoplitis abjecta Sandhouse, 1939, Mem. Ent. Soc. Washington, 1: 139.

This is a moderate sized robust species, similar to *A. nigrior* in the black or reddish black scopa, and black pubescence of the clypeus, legs, and terga. It differs from *nigrior* in the more robust form, finer, sparser punctation, etc.

Female.—Length 7 mm. Pubescence of head grayish white, that of clypeus fuscous and black; punctures of head not dense, in many areas separated by half their diameters, those of clypeus as coarse as coarsest punctures of vertex, dense and arranged in rows only in apical half of clypeus; anterior ocellus farther from antennal bases than from posterior edge of vertex, distance between posterior ocelli equal to distance to eye margin, greater than distance to posterior edge of vertex; pubescence of cheeks sparse, suberect; clypeal truncation rounded at the ends, feebly emarginate medially, slightly shorter than distance from its end to lateral angle of clypeus; mandibles tridentate, a little more than three times as long as shortest breadth, notch between first two teeth not deepened as a narrow sinus, subapical inner swelling distant from apex of third tooth by distance equal to less than half shortest breadth of mandible; apex of second tooth nearer to apex of first than to apex of third (in contrast to other species). Thorax with pubescence grayish white, that of sternum fuscous, punctation of mesoscutum rather fine, disc shining with punctures reduced in size and separated by several times their diameters; mesepisternum more coarsely punctured than mesoscutum, punctures separated by some shining ground in which are a few minute punctures; enclosure of propodeum somewhat roughened above; pubescence of legs black, inner hind tibial spurs curved apically. Abdomen finely and sparsely punctate, punctures of middle of second terga minute and separated by a number of times their diameter; scopa black or reddish black, elongate anteriorly so that longest hairs of second sternum are conspicuously longer than length of second tergum; pubescence of abdominal terga black except for white hairs at posterior margins of first three terga.

Type: from Colorado, in Academy of Natural Sciences of Philadelphia. Although widely distributed in Colorado, the male of this species has never been recognized. It is to be expected that it will be similar to that of its closest relative, *A. alta*. The above description is based on a specimen from Longs Peak Inn, Colorado, 8000 feet, June 30, 1928 (E. C. Van Dyke).

Anthocopa (Atoposmia) alta (Michener)

Osmia alta Michener, 1936, Can. Ent., 68: 41, ♀.
Hoplitis alta Sandhouse, 1934, Mem. Ent. Soc. Washington, 1: 139.

This is a moderate sized, rather robust species, differing from *A. anthodyta* which it closely resembles in general appearance by the thicker

mandibles of the female and the large lateral lobes and reduced median tooth of the sixth tergum of the male. It differs from *A. objecta*, to which it is very closely related, by the pale pubescence, the yellowish or brownish scopa, and the position of the ocelli with relation to the posterior edge of the vertex and the compound eyes.

Female.—Length 6½–7 mm. Pubescence grayish white with a few fuscous hairs intermixed on dorsum of thorax and occupying regions between fasciae on abdominal tergites; pubescence of anterior margin of clypeus yellowish. Punctures of head coarse and rather close, largely separated by one-fourth their diameters or less, those of cheeks and vertex often by half their diameters, those of clypeus about same size as larger punctures of frons and vertex and sometimes conspicuously separated on basal half; anterior ocellus much posterior to midpoint between antennal bases and posterior edge of vertex, distance between posterior ocelli equal to or slightly greater than distance to posterior edge of vertex but less than distance to eye margin; pubescence of cheeks sparse, suberect; clypeal truncation rounded at ends, feebly crenulate, slightly shorter than distance from end of truncation to lateral angle of clypeus; mandibles three-toothed, but little more than three times as long as shortest breadth, outer apical tooth rather short, notch between first and second teeth not or but little deepened into a sinus; distance from apex of first to apex of second tooth equal to or slightly less than distance from second to third; subapical inner swelling distant from apex of third tooth by distance equal to half or slightly over half shortest width of mandible; maxillary palpi longer than first segment of labial palpi, five-segmented, third segment longest. Thorax with punctures of mesoscutum similar to those of frons but more widely separated, disc commonly with punctures reduced in size and separated by several puncture widths; mesepisternum more coarsely and less closely punctured than mesoscutum; upper part of propodeal enclosure strongly roughened except medially; inner hind tibial spurs somewhat bent at apices. Abdomen finely and sparsely punctate, punctures of middle of second tergum minute and separated a number of times their diameters; scopa typically yellow-brown in some lights, sometimes yellow without brown tints, elongate anteriorly, longest hairs of second sternum being considerably longer than length of second tergum; apical pubescent bands of abdominal tergites broken medially on first three terga.

Male.—Length 7–8 mm. Similar to female in appearance and punctation; clypeus more finely and densely punctured than most of frons or vertex; distance between posterior ocelli less than distance to posterior edge of vertex which is less than distance to eye margin; clypeal truncation somewhat crenulate medially, nearly or about four times as long as distance from end to lateral angle of clypeus, impunctate margin of truncation rather broad. Posterior margin of third abdominal sternum with an evident emargination, fringed with long hairs; sixth tergum with a tooth ending in a right or obtuse angle at each side, lateral margins of sixth tergum nearly straight; seventh tergum with lateral lobes rather narrowly rounded and conspicuously exceeding median tooth which is reduced to a mere swelling of the margin.

Type: female; Garnet Lake, California, on loan deposit to the California Academy of Sciences. One female, Lone Pine Canyon, Inyo County, California, 8500 feet, June 11, 1937 (C. D. Michener); one female and two males, Gold Lake, Sierra County, California, July 31, 1921 (C. L. Fox); one male and one female, Science Lodge, west Boulder County, Colorado, July 6, 1939 (U. L. Lanham).

Considerable variation is shown in the small series of this species before me. The female from Science Lodge is very small. Both this specimen and the female from Gold Lake have the mesoscutum more closely punctured than in typical specimens lacking the area of small, widely separated punctures in the center, and the scopa in these individuals shows little or no brown. Males from both these localities, however, have the area of widely separated punctures in the center of the disc of the scutum. In the Gold Lake female, the head is less closely punctate than in the rest, the punctures of the upper part of the clypeus being well separated. While I believe all these to be individual variations, it is possible that they indicate the presence of two or more distinct species. It is also possible that the species will eventually fall as a form of ***abjecta***, to which it is closely related, but the Colorado female of ***alta*** has a very pale scopa, and in no way suggests intergradation with that species.

Anthocopa (Atoposmia) mesae (Cockerell)

Hoplitis mesae COCKERELL, 1930, Am. Mus. Nov., 397: 2.

*A. **mesae*** is the only species of ***Atoposmia*** not known from the female. It is probable, indeed, that it is the male of ***abjecta***, a species known only from the female. This hypothesis is strengthened by the similarity of ***mesae*** to the male of ***alta***, the female of which is very similar to ***abjecta***. However, since no female ***Atoposmia*** are known from southwestern Colorado, from which area ***mesae*** was described, it seems best not to place ***mesae*** in the synonymy of ***abjecta*** until further evidence can be obtained.

Male.—Length 8.5 mm. (abdomen straightened). Pubescence whitish, badly worn in type. Punctures of clypeus and supraclypeal area fine and dense, becoming progressively larger and more widely separated on frons, vertex, and cheeks; clypeus with anterior margin moderately widely impunctate, apex not much produced, truncation slightly sinuate and more than four times as long as distance from end of truncation to lateral angle of clypeus; anterior ocellus behind midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli about equal to distance from one of them to eye margin or to posterior margin of vertex; maxillary palpi five-segmented, third segment longest. Thorax with punctures of mesoscutum mostly similar in size to those of frons but separated by two to four puncture widths medially; mesepisternum closely punctured and much more coarsely so than mesoscutum; upper part of propodeal enclosure strongly roughened; inner hind tibial spurs slightly curved apically. Abdomen finely punctate, punctures of middle of second tergum minute and separated by several times their diameters; posterior margin of third sternum with a distinct broad

emargination; sixth tergum with obtuse tooth at each side; seventh tergum with lateral lobes much exceeding median tooth which is reduced to a mere convexity of the margin.

Type: male; Mesa Verde, Colorado, in the collection of The American Museum of Natural History. This species is known only from the unique type.

Anthocopa (Atoposmia) anthodyta, n. sp.

(Figs. 1, 13, and 22)

This is a moderate sized, robust species which may be distinguished from all others by the greatly narrowed median portion of the mandibles of the female. The male is similar to that of *oregona*, the lateral lobes of the seventh tergum being much reduced, but differs from that species by the slightly acute third mandibular tooth, the absence of an impunctate, longitudinal, median, raised line on the clypeus, etc.

Female.—Length 7½ mm. (varying from 7 to 8 mm.). Pubescence whitish. Punctures of head dense (not so fine as in other densely punctate species, as *triodonta* and *pycnognatha*), those of clypeus somewhat elongate and slightly larger than those of rest of head; anterior ocellus much farther from antennal bases than from posterior edge of vertex; distance between posterior ocelli equal to (sometimes slightly greater than) distance to posterior edge of vertex, which is less than distance to eye margin; pubescence of cheeks sparse, suberect; clypeal truncation broadly rounded at ends, hardly emarginate medially, shorter than distance from its end to lateral angle of clypeus; mandibles tridentate, much narrowed basad to middle so that they are more than four times as long as shortest width, outer tooth long and slender, notch between it and second tooth prolonged as a narrow sinus, subapical inner swelling basad from apex of third tooth by distance nearly equal to shortest width of mandible; maxillary palpi five-segmented, fully as long as first segment of labial palpi, third segment longest. Thorax with mesoscutum conspicuously more coarsely punctured than vertex, punctures close around the margins, separated by less than their diameters even in center of disc; mesepisternum with punctures slightly coarser than those of scutum and more widely separated, especially below, where there are minute punctures interspersed among the larger ones; enclosure of propodeum slightly roughened above medially, more strongly so laterally; inner hind tibial spurs nearly straight. Abdomen with punctures of center of second tergum separated by two or three times their diameters; scopa yellowish white, elongate anteriorly, hairs of second sternum being longer than length of second tergum; apical pubescent bands of abdominal terga broken medially.

Male.—Length 8½ mm. (varying to 7 mm.). Similar to female in appearance and punctation; punctures of clypeus about the size of smaller punctures of vertex; punctures of vertex more widely separated in some areas than in the female; distance between posterior ocelli less than (or equal to) distance to posterior edge of vertex, which is less than (or equal to) distance to eye margin; truncation of

clypeus nearly four times as long as distance from end of truncation to lateral angle of clypeus, crenulate, impunctate margin rather broad; mandibles with inner apical tooth acute, at least in some views. Third abdominal sternum with a broad emargination, fringed with long hairs; lateral teeth of sixth tergum slightly obtuse (varying to somewhat acute), lateral margins of sixth tergum relatively straight (sometimes sinuate or convex next to tooth); seventh tergum with lateral lobes reduced to mere shoulders, much exceeded by the median tooth.

Holotype female (Calif. Acad. Sci., Ent. No. 5156), allotype male (Calif. Acad. Sci., Ent. No. 5157), and ten paratypes: Lone Pine Canyon, Inyo County, California, 8500 feet elevation, June 11, 1937 (C. D. Michener). Two paratypes no doubt from same locality but labeled Mt. Whitney, Inyo County, California, June 12, 1937 (collector unknown, Bohart collection). Numerous additional specimens are from Mill Creek, San Bernardino Mountains, California, 6000 feet, on *Pentstemon grinnelli* June 20, 1937, June 26, 1938, and August 30, 1940 (P. H. Timberlake).

Anthocopa (Atoposmia) elongata (Michener)

(Fig. 27)

Osmia elongata MICHENER, 1936, Can. Ent., 68: 41.
Hoplitis elongata SANDHOUSE, 1939, Mem. Ent. Soc. Washington, 1: 139.

This is the smallest species in the subgenus, and is quite slender.

Female.—Length 6 to nearly 7 mm. Pubescence white or nearly so. Punctures of head not dense, except immediately behind the ocelli for the most part separated by about half their diameters, those of clypeus coarser than those elsewhere; anterior ocellus much nearer to posterior edge of vertex than to antennal bases; distance between posterior ocelli equal to or slightly less than distance to eye margin, which distance is markedly greater than distance to posterior edge of vertex; pubescence of cheeks sparse, suberect; clypeal truncation much produced, broadly rounded at the ends, slightly emarginate medially; mandibles tridentate, little over three times as long as shortest breadth, outer tooth short and robust for *Atoposmia*, notch between first and second mandibular teeth not prolonged into a narrow sinus, distance between subapical inner swelling and apical tooth a little over half shortest breadth of mandible; maxillary palpi as long as first segment of labial palpi, five-segmented, third segment longest. Thorax strongly punctate, mesoscutum with punctures separated by much less than half their diameters and as large as largest punctures of vertex, no discal area of more widely separated punctures; mesepisterna, especially below, with punctures larger and more widely separated than those of scutum and with a few minute punctures interspersed among them; enclosure of propodeum but little roughened above medially; inner hind tibial spur straight. Abdomen finely and sparsely punctate middorsally, punctures of middle of second tergum separated by several times their diameters; scopa yellowish white, much elongated anteriorly, hairs of second sternum almost twice as

long as second tergum; apical pubescent bands of anterior abdominal terga broken medially.

Male.—Length 6 mm. Similar to female in appearance and punctation; clypeus little if any more coarsely punctate than certain areas of frons and vertex; distance between posterior ocelli equal to distance to posterior edge of vertex, which is less than distance to eye margin; clypeal truncation slightly produced so that normal lateral apical angles of clypeus are on lateral apical margins and the slightly crenulate truncation, which has an impunctate margin of moderate width and distinct (not rounded) angles at the ends, is only one and one-half times as long as distance from end of truncation to lateral angle of clypeus. Third abdominal sternum with distinct emargination in posterior margin, hairs forming fringe of emargination rather short; lateral angles of sixth tergum obtuse and slightly rounded; lateral lobes of seventh tergum reduced to rounded shoulders, median tooth reduced to short, obtuse projection.

Type: female; Bluff Lake, San Bernardino Mountains, California, on loan deposit in the California Academy of Sciences. Additional specimens, apparently belonging to this species but slightly smaller than the type, are two females from the North Fork of Bishop Creek, Inyo County, California, 8500 feet elevation, June 22, 1937, one on *Phacelia* (C. D. Michener); one male, Glacier Lodge, near Big Pine, Inyo County, California, June 23, 1937 (E. C. Van Dyke); one male, Truckee, California, June 17, 1927 (E. P. Van Duzee); and one female, Mammoth, Mono County, California, July 25, 1936 (G. E. and R. M. Bohart).

Anthocopa (Atoposmia) triodonta (Cockerell)

Osmia (Atoposmia) triodonta COCKERELL, 1935, Pan-Pac. Ent., 11: 50.
Hoplitis triodonta SANDHOUSE, 1939, Mem. Ent. Soc. Washington, 1: 140.

This is a rather large, robust species, closely resembling *pycnognatha* in the dense punctation, but differing markedly from that species by the longer, five-segmented maxillary palpi.

Female.—Length 7–8 mm. Pubescence white or grayish white. Punctures of head for the most part dense, although not confluent, those of clypeus but little coarser than those of frons; anterior ocellus about midway between posterior edge of vertex and antennal bases or but little posterior to midpoint; distance between posterior ocelli less than distance to posterior edge of vertex, which distance is less than that to eye margin; pubescence of cheeks abundant, depressed and directed foreward; clypeal truncation simple or sometimes weakly sinuate so that there is a feeble rounded projection at each side of the middle, truncation about as long as distance from its rounded end to lateral angle of clypeus; mandibles slightly less than three times as long (measured along lower side) as shortest breadth, tridentate, notch between first and second teeth not prolonged into a sinus, subapical dorsal swelling rounded and distant from apex of third tooth by about half of shortest breadth of mandible; maxillary palpi as long as first segment of labial palpi, five-segmented, third segment much the longest. Thorax less closely and more coarsely punctate than

head, with a few fine punctures intermixed with the larger ones on mesoscutum and mesepisterna; enclosure of propodeum roughened above; inner hind tibial spurs distinctly bent at apices. Abdomen strongly punctate, punctures of middle of second tergum separated by more than their diameters; scopa yellowish white, elongate, longest hairs of second sternum twice as long as length of second tergum; apical pubescent bands of terga except the first complete.

Male.—Length 8–9 mm. Similar to female in appearance. Clypeus more finely punctate than rest of head; distance between posterior ocelli equal to or shorter than distance to eye margin, which distance is shorter than that to posterior edge of vertex; clypeal truncation not produced, over three times as long as distance from end of truncation to lateral angle of clypeus, truncation feeble crenulate. Third abdominal sternum with conspicuous, broad, fringed emargination; sixth tergum with an acute tooth at each side, lateral margins straight; seventh tergum with median tooth reduced to a mere angle, lateral lobes large and narrowly rounded.

Anthocopa triodonta triodonta (Cockerell)

(Figs. 2, 12, and 25)

Punctures of cheeks in both sexes rather coarse, but little finer than largest punctures of vertex; impunctate anterior margin of clypeus of male very narrow.

Type: male; Mount Diablo, Contra Costa County, California, 3800 feet elevation. A topotype with the same data was collected by Dr. R. M. Bohart.

Anthocopa triodonta usingeri, n. subsp.

Punctures of cheeks in both sexes finer than those of much of vertex and exceedingly dense; impunctate anterior margin of clypeus of male moderate in width.

Holotype male (Calif. Acad. Sci., Ent. No. 5166), allotype female (Calif. Acad. Sci., Ent. No. 5167) and four paratypes from Santa Rosa Mountain, San Jacinto Mountains, California, 5800 feet elevation, May 31, 1940, on *Pentstemon spectabilis.* Two paratypes, same locality, 6200 feet elevation, on *Nama parryi,* one May 31, 1940, the other June 11, 1940; seven paratypes, Vandevanter Flat, San Jacinto Mountains, June 11, 1940, on *Pentstemon spectabilis* (all C. D. Michener). Additional specimens are from Ribbonwood, San Jacinto Mountains, California, May 21, 1940 (C. D. Michener); Cajon Valley, San Gabriel Mountains, California, June 3, 1929 (E. G. Anderson). The original allotype female of *triodonta* from Lone Pine Canyon, San Gabriel Mountains, California, 5900 feet elevation, June 16, 1928, on *Pentstemon spectabilis* (P. H. Timberlake) belongs to *usingeri.*

This form is named for Dr. Robert L. Usinger, with whom I was collecting in the San Jacinto Mountain region when the type material was taken.

Anthocopa (Atoposmia) shastensis (Cockerell)

Osmia shastensis COCKERELL, 1935, Pan-Pac. Ent., 11: 46.

Female.—Similar to description of *A. triodonta* but pubescence of clypeus, mandibles, tibiae, and tergites except posterior margins largely black; scopa reddish, black laterally and posteriorly in some individuals; short appressed pubescence near eye margin dusky or blackish and therefore inconspicuous. Punctures of cheeks as in *A. triodonta triodonta*.

Male.—Differs from *A. triodonta* in the slightly coarser and less dense punctures of the cheeks, the fine and widely separated abdominal punctures (those of middorsal area of second tergum being separated by several times their diameters), and the presence of black hairs on the abdominal terga. The genitalia are apparently indistinguishable from those of *A. triodonta*.

Type: Female; Shasta County, California, in the Timberlake collection at the Citrus Experiment Station of the University of California, Riverside. Additional records: one female, Lake Almador, California, July 22, 1937 (F. X. Williams); one male, Summit Lake, Mount Lassen, California, 6700 feet elevation, July 21–22, 1937 (F. X. Williams); one male with abdominal punctation a little coarser than in the above male specimen, Carrville, Trinity County, California, 2400 to 2500 feet elevation, May 31, 1934 (G. E. Bohart).

This form is possibly a subspecies of *A. triodonta*, as has been suggested to me by Mr. P. H. Timberlake. The punctation of the cheeks and the width of the impunctate margin of the clypeus are as in *P. triodonta triodonta*, but the abdominal punctation of the male is much finer than in that species.

Anthocopa (Atoposmia) pycnognatha, n. sp.

(Fig. 29)

Although but slightly larger than *A. triodonta*, this robust species is the largest form in the subgenus. It may be distinguished easily from other species by the short, four-segmented maxillary palpi. The close punctation and broad, robust mandibles of the female suggest that this species is most closely related to *A. tridonta*, from which it differs by the convex lateral margins of the sixth tergum of the male, in addition to other characters.

Female.—Length nearly 8 mm. Pubescence brownish white; punctures of head for the most part dense, although not confluent, those of clypeus but little coarser than those of frons; anterior ocellus about midway between posterior edge of vertex and antennal bases; distance between posterior ocelli shorter than distance to posterior edge of vertex, which latter is shorter than distance to eye margin; pubescence of cheeks abundant, depressed and directed foreward; clypeal truncation simple, about as long as distance from its rounded end to lateral angle of clypeus; mandibles slightly less than three times as long (measured from lower basal angle) as shortest breadth, tridentate, notch between first and second teeth not prolonged into a

sinus, subapical dorsal swelling rounded and distant from apex of third tooth by about half of shortest breadth of mandible; maxillary palpi four-segmented, little more than half as long as first segment of labial palpi, segments from longest to shortest being (2, 3) (1) (4). Thorax rather closely punctured, although not so closely so as head, and more coarsely so than head; enclosure of propodeum roughened above; inner hind tibial spurs distinctly bent at apices. Abdomen strongly punctate, punctures of second tergum except for small area medially separated by their diameters or less; scopa yellowish white, elongate, hairs of second sternum nearly twice as long as length of exposed part of second tergum; apical pubescent bands of terga complete except on first.

Male.—Length 9 mm. (varying to 8 mm. among paratypes). Similar to female in appearance and punctation but clypeus more finely punctate than rest of head; distance between posterior ocelli less than distance to eye margin, which distance is less than that to posterior margin of vertex; clypeal truncation slightly produced, less than twice as long as distance from end to lateral angle of clypeus, demarked by distinct, slightly produced angles, median half of truncation finely denticulate; impunctate margin of truncation extremely narrow. Third abdominal sternum with conspicuous, broad, fringed emargination; sixth tergum with a tooth at each side, ending in a right angle, lateral margins of sixth tergum strongly convex; seventh tergum with median tooth hardly (if at all) exceeding rounded lateral lobes.

Holotype female (Calif. Acad. Sci., Ent. No. 5158), allotype male (Calif. Acad. Sci., Ent. No. 5159), and five male paratypes: Oak Creek Canyon, near Independence, Inyo County, California, June 11, 1937, on *Penstemon breviflorus* (C. D. Michener). One male and one female paratype no doubt from same locality but labeled merely Independence, Inyo County, California, June 11, 1937 (Bohart collection).

Anthocopa (Atoposmia) panamintensis, n. sp.

(Figs. 3, 4, 14, and 24)

A moderate sized, rather slender species, easily distinguished from all other known forms by the quadridentate mandibles and modified clypeal margin of the female and the nearly straight median portion of the apical margin of the third sternum of the male.

Female.—Length 7 mm. Pubescence white or grayish white. Punctures of head nowhere dense, in most areas separated by slightly less than half their diameters, those of clypeus little if at all coarser than those of frons; anterior ocellus nearer to posterior edge of vertex than to antennal bases, distance between posterior ocelli equal to distance from posterior ocellus to eye margin, and equal to distance from posterior ocellus to posterior margin of vertex; pubescence of cheeks sparse, suberect; clypeal truncation rounded at ends, shorter than distance from its end to lateral angle of clypeus, furnished medially with a pair of teeth demarking a small, deep median emargination; mandibles more than three and one-half times as long

(measured from lower, basal angle to apex) as shortest breadth, quadridentate, notch between first and second teeth prolonged into a narrow sinus, fourth tooth shorter than others; maxillary palpi as long as first segment of labial palpi, five-segmented, segments, from longest to shortest, being (3, 4) (2) (1) (5). Thorax with punctures of disk of mesoscutum and of mesepisterna coarser and sparser than those of head, with a few minute ones interspersed among them; margins of mesoscutum with finer, closer punctures; enclosure of propodeum conspicuously although finely roughened above; inner hind tibial spurs but feebly bent at apices. Abdomen rather strongly punctate, punctures of median part of second tergum separated for the most part by less than twice their diameters; scopa white, short, longest hairs of second sternum shorter than length of exposed portion of second tergum; apical pubescent bands of terga broadly broken medially.

Male.—Length 7 mm. (6 mm. in one paratype). Similar to female in appearance and in punctation but clypeus considerably more finely and closely punctate than rest of head and sides of vertex rather closely punctate; distance between posterior ocelli equal to distance from one of them to posterior edge of vertex, greater than distance to eye margin; clypeal truncation feebly, irregularly crenulate, rather broadly impunctate, about twice as long as distance from its rounded ends to lateral angle of clypeus. Third abdominal sternum with broad, very shallow emargination on posterior margin, furnished with a conspicuous fringe; sixth tergum with a tooth at each side ending in about a right angle (sometimes slightly acute or obtuse); lateral margins of sixth tergum conspicuously convex; seventh tergum with median tooth broad and obtuse, exceeding lateral lobes, which in the allotype are greatly reduced.

Holotype female (Calif. Acad. Sci., Ent. No. 5160), allotype male (Calif. Acad. Sci., Ent. No. 5161), one female paratype, and seven male paratypes: Tuber Canyon, Panamint Mountains, Inyo County, California, 8000 feet, June 18, 1937, on damp ground beside a small spring (C. D. Michener).

An additional male specimen from Wild Rose Canyon, Panamint Mountains, Inyo County, California, 7500 feet, June 18, 1937, differs from the others primarily in the absence of a median tooth on the seventh tergum.

Subgenus **Eremosmia,** n. subg.

Type species: *Osmia robustula* Cockerell.

Black without metallic tints; eyes with inner margins subparallel or but feebly converging below in females, diverging below in males; mandibles of both sexes tridentate, those of female slender, more than four times as long as shortest breadth; trophi short, when folded not reaching behind fore coxae, first segment of labial palpi over half as long as second; longitudinal carina of inner ventral angle of posterior coxae strong; scopa of female not elongated, male with second sternum somewhat to much enlarged; sixth tergum of male with a tooth or

angle at each side, seventh tergum exposed, with a median apical tooth.

This is a subgenus which has thus far been found only in the desert regions of eastern California.

KEY TO THE SPECIES OF THE SUBGENUS EREMOSMIA

FEMALES

1. Abdominal terga wholly black, punctation extending to their extreme posterior margins (p. 67) ..... **mallognatha**
   Abdominal terga with posterior margins brown or reddish, narrowly impunctate 2
2. Upper part of clypeus strongly convex, shining, and largely impunctate; distance between first two mandibular teeth considerably less than distance from second to third tooth (p. 68) ..... **laevibullata**
   Upper part of clypeus punctate, less strongly convex; distance between first two mandibular teeth equal to or greater than distance between second and third 3
3. Femora red; punctures of center of scutum little if at all larger than coarser punctures of vertex 4
   Femora black; punctures of center of scutum markedly coarser than those of vertex 5
4. Abdomen largely covered with appressed, white pubescence; clypeus without a longitudinal, median impunctate area (p. 69) ..... **timberlakei**
   Abdomen with white pubescence primarily confined to posterior margins of tergites; clypeus with longitudinal, median impunctate band (p. 70), **nitidivitta**
5. Mandibles with subapical swelling of inner margin large and ending distally in a right angle; clypeus and mandibles black (p. 71) ..... **robustula**
   Mandibles with subapical swelling of inner margin feeble and rounded; mandibles largely red, anterior margin of clypeus red (p. 72) ..... **rupestris**

MALES

1. Penultimate antennal segment longer than broad; mandibles with distance between apices of first two teeth nearly twice distance between apices of second and third teeth (p. 71) ..... **robustula**
   Penultimate antennal segment broader than long; mandibles with apices of teeth nearly equidistant 2
2. Femora red; punctures of cheeks and mesepisternum about equally coarse (p. 70) ..... **nitidivitta**
   Femora black; punctures of cheeks much finer than those of mesepisternum (p. 72) ..... **rupestris**

Anthocopa (Eremosmia?) mallognatha, n. sp.

This is a rather large, coarsely punctate, black species, with but little pale pubescence. The parallel sided abdomen gives it the aspect of a species of *Phaeosmia*. However, although the male is unknown, I place this species in *Eremosmia* because of the slender mandibles and parallel inner margins of the eyes. In *Phaeosmia* it resembles *A. enceliae*, from which it differs, in addition to the characters mentioned above, by the reduced pubescence. In *Eremosmia* it is possibly closest to *laevibullata*, from which it differs in larger size, coarser punctation, punctate upper part of clypeus and posterior margins of terga, etc.

Female.—Length 7½ mm. Pubescent sparse, whitish, brushes of short hair under margin of clypeus and large dense tuft on outer surface of each mandible near apex orange; pubescence of tergites except for white bands at posterior margins light fuscous. Inner

orbits of eyes practically parallel; clypeus produced to a broad, gently concave truncation with rounded ends, truncation about as long as distance from its end to lateral angle of clypeus; produced closely punctured region of truncation with surface (seen in profile) directed anteriorly, at an angle to the rest of the clypeus which is convex and less closely punctured; head coarsely punctured, punctures (except for frons where they are closer) for the most part slightly separated by shiny ground, those of clypeus about twice as large as those of sides of face and supraclypeal area, but little larger than those of frons and vertex; median ocellus but little posterior to midpoint between posterior edge of vertex and antennal bases; distance between posterior ocelli slightly less than distance to eye margin, which is slightly less than that to posterior edge of vertex; second mandibular tooth approximately equidistant between first and third teeth; maxillary palpi four-segmented, segments two and three subequal and long, first shorter, fourth shortest, broad oval. Thorax coarsely and densely punctate, anterior median portion of mesoscutum with a small area of widely separated punctures, punctures of scutum coarser than those of vertex, as coarse as those of clypeus, those of mesepisterna coarser than those of scutum especially below; enclosure of propodeum roughened above; tegulae black; hind tibial spurs feebly curved apically; wings brownish. Abdominal terga strongly punctured, punctures middorsally mostly separated by two or three times their diameters but those near apical margins of terga (which are wholly black) finer and closer; posterior margins of terga one to four with very narrow, inconspicuous bands of white pubescence laterally; scopa yellowish white.

Holotype (Calif. Acad. Sci., Ent. No. 5162): seven miles west of Lone Pine, Inyo County, California, June 2, 1937 (C. D. Michener).

Anthocopa (Eremosmia) laevibullata, n. sp.
(Fig. 10)

This small, fine punctate species lacks the *Phaeosmia*-like aspect of *mallognatha*, but is nevertheless perhaps more closely related to that species than to any other, as indicated in particular by the shape of the clypeus. It differs from that form by the smaller size, finer punctation, impunctate upper convexity of the clypeus, impunctate posterior margins of the abdominal terga, etc.

Female.—Length nearly 7 mm. (5½ mm. in paratype). Pubescence dull whitish, that of dorsum of abdomen, except for posterior margins of tergites pale fuscous; anterior margin of clypeus and outer faces of mandibles without brushes or tufts of hair. Inner orbits of eyes feebly converging below; clypeus produced to a truncation, the ends of which are angulate, and the length of which is considerably less than distance from its end to lateral angle of clypeus; produced portion of clypeus coarsely longitudinally strigose punctate, directed anteriorly (as seen in profile) at an angle to rest of clypeus which is convex and nearly impunctate (with few scattered punctures) centrally; except for the clypeus whose punctures are coarse, the head is finely punctured, closely so on frons, but little less closely so elsewhere; median

ocellus much farther from antennal bases than posterior edge of vertex; distance between posterior ocelli equal to distance to posterior edge of vertex, less than distance to eye margin; mandible with inner subapical swelling feeble and gently rounded, second mandibular tooth separated from first by but little more than half distance separating it from third; maxillary palpi five-segmented, segments two to four subequal in length, one and five shorter. Thorax finely punctate, punctures of mesoscutum slightly finer than those of vertex and separated by about half their diameters; mesepisternum similarly punctured, much more sparsely so below; enclosure of propodeum roughened above; tegulae black; hind tibial spurs feebly curved apically; wings slightly grayish. Abdomen rather strongly punctured, middorsal portion of second tergum with punctures separated by two or three times their diameters; posterior margins of terga feebly brownish, narrowly impunctate, provided with distinct narrow bands of white pubescence, that of first tergum broken medially; scopa brownish white.

Holotype (Calif. Acad. Sci., Ent. No. 5169): Truckee, California, June 14, 1927 (E. P. Van Duzee). One paratype, Lake Spaulding, Nevada County, California, June, 1938, on pussy-paws (I. McCracken).

Anthocopa (Eremosmia) timberlakei (Cockerell)

Osmia timberlakei COCKERELL, 1935, Pan-Pac. Ent., 11: 41.

This species is easily distinguished from others in the genus by the red femora, appressed pale pubescence covering almost the entire dorsum of the abdomen, and the closely punctured clypeus.

Female.—Length 7½–8 mm. Pubescence dull whitish, brushes of hair under margin of clypeus and tuft of hair on outer face of mandible, subapically, small and orange. Inner margins of eyes parallel; anterior margin of clypeus produced to a very feebly concave truncation with broadly rounded ends; produced portion of clypeus not much directed anteriorly, rather densely punctured, punctures of clypeus little if any larger than those of sides of face and frons but markedly larger than those of vertex and cheeks; median ocellus somewhat posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli greater than distance to posterior edge of vertex, which distance equals that to eye margin; mandibles red subapically, apex of second tooth slightly nearer third tooth than first; maxillary palpi five-segmented, second and third segments subequal in length and longer than any of the others, fourth segment somewhat shorter, fifth yet shorter. Thorax finely and rather closely punctate, mesoscutum with punctation similar to that of vertex, mesepisternum with punctures considerably coarser and sparser, especially below; enclosure of propodeum shining to upper margin except laterally; femora red; tegulae rufotestaceous; hind tibial spurs curved apically; wings nearly clear. Abdomen with fine punctures, those of middorsal region of second tergum separated by two to three times their diameters; posterior margins of terga narrowly brownish and more narrowly impunctate; abdominal terga covered with

appressed, white pubescence, first three terga with transverse middorsal areas bare; scopa yellowish white.

Type: Opposite sand dunes (north of Palm Springs), road to Palm Springs, Riverside County, California, in the Timberlake collection at the Citrus Experiment Station of the University of California, Riverside, California. An additional specimen is from nine miles north of Adelanto, Mojave Desert, April 25, 1937, on *Astragalus fremontii* (P. H. Timberlake).

Anthocopa (Eremosmia) nitidivitta, n. sp.

(Figs. 6, 16, and 26)

This species resembles *A. timberlakei* in the red femora, but differs from that species in the distinct pubescent bands on the posterior margins of the abdominal terga, and the more coarsely punctate clypeus which is furnished with a longitudinal impunctate line.

Female.—Length 7 mm. (varying to 7½ mm.). Pubescence dull whitish, brushes of hair under margin of clypeus and tuft of hair on outer faces of mandibles, subapically, small and orange. Inner margins of eyes parallel; anterior margin of clypeus reddish medially, produced to a truncation (with broadly rounded ends) which is markedly shorter than distance from end of truncation to lateral angle of clypeus; produced portion of clypeus not directed anteriorly; clypeus with longitudinal median impunctate band which is narrowed and elevated on apical half, punctures of clypeus large, somewhat elongated, separated by some shiny ground; punctures of frons and sides of face finer than those of clypeus, slightly separated, those of rest of head still finer and approximate; median ocellus somewhat posterior to midpoint between antennal bases and posterior edge of vertex; distance between posterior ocelli equal to distance to posterior edge of vertex, slightly greater than distance to eye margin; mandibles red, bases black, apices dark brown (or black); subapical inner swelling low and rounded; apex of second tooth slightly nearer apex of third than apex of first; maxillary palpi five-segmented, third segment longer than any other, second shorter, first, fourth and fifth still shorter and subequal. Thorax rather finely and closely punctured, mesoscutum with punctation similar to that of vertex, mesepisternum with punctures coarser and sparser than those of mesoscutum; enclosure of propodeum shining to upper margin except laterally; femora red; tegulae rufotestaceous; hind tibial spurs pale testaceous, curved apically; wings slightly dusky. Abdomen with fine punctures, those of middorsal region of second tergum separated by several times their diameters; posterior margins of abdominal terga brownish, narrowly impunctate, with broad bands of white pubescence; scopa whitish.

Male.—Length 7½ mm. (varying to 6½ mm.). Similar to female in appearance and pubescence; inner margins of eyes strongly diverging below; anterior margin of clypeus not reddish, but little produced, truncation rounded at ends and about six times as long as distance from its end to lateral angle of clypeus; punctures of clypeus finer than in female, impunctate band absent on lower part of clypeus; punctures of frons closer than in female, those of cheeks sparser than in female;

mandibles red except bases and apices, slender, width at third tooth greater than width at base, apex of second tooth slightly nearer apex of third than of the elongate first tooth; punctures of mesepisterna not coarser than those of mesoscutum, although sparser. Posterior margins of abdominal terga broadly translucent testaceous; sixth tergum produced to a slender median tooth; second sternum large, covering most of third, posterior margin feebly emarginate medially; third tergum without deep posterior emargination, but with median fringed section; fourth sternum produced posteriorly to a median, broadly rounded angle.

Holotype female (Calif. Acad. Sci., Ent. No. 5163) and one female paratype: six miles north of Wild Rose Canyon, Panamint Mountains, Inyo County, California, 5000 feet elevation, May 28, 1937, *Phacelia* (C. D. Michener). Allotype male (Calif. Acad. Sci., Ent. No. 5164) and two female paratypes: West side of Westgard Pass, Inyo County, California, May 27, 1937, one on *Parosela fremontii* (E. C. Van Dyke, C. D. Michener). Paratypes: one female near Kearsarge, Inyo County, California, May 25, 1937 (E. C. Van Dyke), one female and one male, Wild Rose Canyon, Panamint Mountains, Inyo County, California, 7000 feet elevation, May 27, 1937 (C. D. Michener), two females nine miles north of Adelanto, Mojave Desert, California, April 25, 1937, on *Astragalus fremontii* (P. H. Timberlake). Paratypes will be placed in the collection of Mr. P. H. Timberlake, the California Academy of Sciences, and the author.

Anthocopa (Eremosmia) robustula (Cockerell)

(Figs. 5, 15, and 30)

Osmia robustula COCKERELL, 1935, Pan-Pac. Ent., 11: 44.

This is a robust, abundantly pubescent species, apparently the most common species of the subgenus, and the most abundant desert representative of the genus.

Female.—Length 7–8 mm. Pubescence white, brushes of hair under margin of clypeus short but broad and orange, mandibles with area of dense orange hairs on outer surface subapically. Inner margins of eyes very slightly diverging below; anterior margin of clypeus produced to a broadly rounded truncation with rounded ends, length of truncation about equal to distance from end of truncation to lateral angle of clypeus; produced portion of clypeus not directed anteriorly; head finely punctate, punctures but little separated, except those of apical half of clypeus which are coarse, and become widely separated as impunctate margin of truncation is approached; anterior ocellus midway between antennal bases and posterior edge of vertex; distance from posterior ocellus to eye margin less than distance between posterior ocelli, which distance is less than that to posterior edge of vertex; mandibles sometimes feebly reddish subapically, subapical inner swelling high and truncated right-angularly distally, apex of median tooth slightly nearer apex of third tooth than apex of the long first tooth; maxillary palpi five-segmented, second longest, third slightly shorter, fourth slightly shorter than third, first very short, fifth variable (minute to nearly as long as first). Thorax much more

coarsely punctate than head, punctures of mesoscutum coarse and nearly confluent, those of mesepisternum of the same size but more widely separated; enclosure of propodeum shining and impunctate to dorsal margin except laterally; tegulae dark testaceous; hind tibial spurs bent apically; wings nearly clear. Abdomen well punctured, central part of second tergum with punctures separated by little over a diameter; posterior margins of abdominal terga feebly brownish, narrowly impunctate, with broad bands of white pubescence; scopa white.

Male.—Length 7–7½ mm. Similar in appearance to female. Inner margins of eyes somewhat divergent below; anterior margin of clypeus but little produced, the truncation nearly five times as broad as distance from end of truncation to lateral angle of clypeus, margin of truncation slightly convex and strongly crenulate; face below anterior ocellus covered with long white hair so that surface sculpture cannot be seen; punctures of clypeus fine and close; subapical portion of mandibles reddish, apical tooth very long, its apex more than twice as far from apex of second tooth as latter is from apex of third tooth which is right angular or somewhat acute; thorax less coarsely punctate than in female; sixth tergum with very feebly produced, slightly rounded angles at the sides; seventh tergum almost hidden, apex broadly rounded; second sternum large, feebly emarginate posteriorly, almost entirely covering third, which is broadly and deeply emarginate posteriorly with a fringe in median part of emargination; fourth sternum broadly rounded posteriorly.

Type: female; from north of Indio, California, in the Timberlake collection, Citrus Experiment Station of the University of California, Riverside, California. Additional localities: Cathedral City, Riverside County, California, April 10, 1936, on *Parosela schottii* (C. D. Michener); Big Pine, Inyo County, California, June 8, 1937, on *Parosela polyadenia* (E. C. Van Dyke, C. D. Michener); near Kearsarge, Inyo County, California, May 25, 1937 (E. C. Van Dyke); Lone Pine, Inyo County, June 15, 1937, on *Parosela polyadenia* (E. C. Van Dyke, C. D. Michener).

The male of this species is here described for the first time.

Anthocopa (Eremosmia) rupestris (Cockerell)

(Figs. 7, 17, and 31)

Osmia rupestris COCKERELL, 1935, Pan-Pac. Ent., 11: 46.

This is a rather sparsely pubescent species with the mandibles largely red, the anterior margin of the clypeus red and small parts of the legs red. The male here placed with it has never been collected with the female, so that the association of the two forms as sexes of one species is somewhat doubtful. However, no other female with which the male could be placed is known.

Female.—Length 6–8 mm. Pubescence dull white, brushes of hair under margin of clypeus orange, very long and broad; mandible without subapical tuft of hair on outer side. Inner margins of eyes slightly converging below; anterior margin of clypeus produced to a rounded truncation (margined with red) longer than distance from

end of truncation to lateral angle of clypeus, produced portion of clypeus not directed anteriorly; head rather finely and closely punctured throughout, clypeus more coarsely so than frons and vertex; anterior ocellus farther from antennal bases than from posterior edge of vertex; distance between posterior ocelli equal to or slightly less than distance to posterior edge of vertex, which is equal to distance to eye margin; mandibles red except for extreme bases and apices, apex of second tooth about midway between apex of first and of third tooth, inner subapical swelling practically absent; maxillary palpi four-segmented, second segment longest, third shorter, fourth shorter than third. Thorax less closely and more coarsely punctured than head, punctures of mesoscutum markedly coarser than those of vertex, those of mesepisterna coarser and sparser than those of scutum; upper part of enclosure of propodeum roughened except at the middle; tegulae rufotestaceous; extreme apices of femora and bases of tibiae, and apices of tibiae and bases of basitarsi reddish; posterior tibial spurs slightly curved at apices; wings brownish. Abdomen rather strongly punctured, punctures of center of second tergum separated for the most part by about twice their diameters; posterior margins of abdominal terga rather broadly reddish, narrowly impunctate, and clothed with rather inconspicuous bands of sparse white hair; scopa yellowish white.

Male.—Length 6½-9½ mm. Similar in appearance to the female but face below antennae more densely covered with white pubescence; clypeus short, but little produced, truncation of apical margin not red, feebly concave, nearly six times as long as distance from its end to lateral angle of clypeus; inner margins of eyes strongly diverging below; distance between posterior ocelli less than distance to eye margin, which distance is less than that to posterior margin of vertex; mandibles unusually long and slender, wider at extreme base than elsewhere, second tooth with apex about midway between apices of first and third teeth, third tooth acute. Thorax less coarsely punctured than in female, mesoscutum punctured much like vertex, mesepisternum more coarsely so. Abdomen with dorsum very finely and sparsely punctate; sixth tergum with an inconspicuous, broad, obtusely rounded angle at each side; seventh tergum with an acute median tooth, the margin laterad to tooth convexly rounded; second sternum somewhat enlarged, only very feebly emarginate posteriorly; third sternum with posterior margin broadly and deeply emarginate, emargination fringed with very long hairs; fourth sternum with posterior margin broadly rounded.

Type: female, Big Rock Creek, California, in Timberlake collection, Citrus Experiment Station, University of California, Riverside, California. Additional specimens: one male, Tahquitz Canyon, near Palm Springs, California, on *Larrea divaricata*, March 24, 1936, (Dammers); one female, ten miles east of Mecca, California, April 14, 1935 (C. D. Michener); one female, Andreas Canyon, near Palm Springs, California, on *Eriodictyon crassifolium*, April 10, 1936 (C. D. Michener); three males, Mazourka Canyon, Inyo Mountains, Inyo County, California, 9500 feet elevation, June 1, 1937 (C. D. Michener).

Subgenus **Hexosmia,** n. subg.

Type species: *Osmia copelandica* Cockerell.

With green and bronz metallic tints on body; eyes conspicuously converging below in both sexes; mandibles of male bidentate, of female tridentate, about three times as long (along lower margin) as shortest breadth; trophi rather short, when folded reaching fore coxae, not provided with hooked hairs; first segment of labial palpi about two-thirds as long as second. Longitudinal carinae of inner ventral angles of posterior coxae inconspicuous. Scopa of female not unusually elongated; male with second sternum very large and largely covering following sterna; sixth tergum broadly rounded, edentate; seventh tergum hidden by sixth, likewise broadly rounded.

This subgenus may be distinguished by the metallic color alone from all other American *Anthocopa.*

KEY TO SUBGENUS HEXOSMIA

1. Distance between first and second mandibular teeth of female distinctly greater than that between second and third; maxillary palpi three segmented (p. 74) ..... **phaceliarum**
   Distance between first and second mandibular teeth of female about equal to distance between second and third; maxillary palpi four-segmented 2
2. Tegulae rufotestaceous; female with punctures of middle of dorsum of second abdominal tergum separated for the most part by about twice their diameters (p. 76) ..... **arefacta**
   Tegulae black or brownish black; punctures of dorsum of second abdominal tergum separated at most by but little more than their diameters 3
3. Punctures of middorsal area of second abdominal tergum in female separated for the most part by about their diameters (p. 75) ..... **copelandica**
   Punctures of middorsal area of second abdominal tergum in female separated by much less than their diameters (p. 77) ..... **albomarginata**

Anthocopa (Hexosmia?) phaceliarum (Cockerell)

Osmia phaceliarum Cockerell, 1935, Pan-Pac. Ent., 11: 45.

Since the male of this species is unknown its subgeneric position cannot be determined with certainty. Although it is not closely related to the other *Hexosmia*, which constitute a compact group, it has seemed best to place it in that subgenus for the time being because of the rather robust mandibles and greenish lustre.

Female.—Length about 6 mm. Pubescence white. Inner orbits converging below, clypeus densely punctured with apical truncation very feebly concave, demarked by rounded angles, and about as long as distance from end of truncation to lateral angle of clypeus; distance between posterior ocelli equal to distance to posterior edge of vertex, and equal to distance to eye margin; mandibles with apical half, except margin, red, the distance between the first and second teeth greater than that between the second and the acute third, notch between first and second rounded and deeper than that between second and third, subapical inner swelling, low and rather far from apex of third tooth; maxillary palpi very short, with three segments subequal in length, basal one about as broad as long, the two following increasingly slender. Upper part of enclosure of propodeum roughened;

tegulae bright ferruginous; wings dusky hyaline; abdomen with posterior margins of terga rufous and with narrow white hair bands, broken on terga one to three; scopa white.

Type: Puente Hills, near Whittier, California, in the Timberlake collection at the Citrus Experiment Station of the University of California, Riverside, California. The species is known only from the unique type.

Anthocopa (Hexosmia) copelandica (Cockerell)

(Figs. 11 and 20)

Osmia copelandica COCKERELL, 1908, Entom., 41: 59; COCKERELL, 1910, Psyche, 10: 246; COCKERELL, 1919, Jour. N. Y. Ent. Soc., 27: 300; COCKERELL, 1928, Univ. Colo. Studies, 16: 124.
Hoplitis copelandica SANDHOUSE, 1939, Mem. Ent. Soc. Washington, 1: 139.
Osmia besseyae COCKERELL, 1910, Entom., 43: 92; COCKERELL, 1928, Univ. Colo. Studies, 16: 124.

This is a small, slender, feebly metallic species.

Female.—Length 6–8 mm. Pubescence white, brushes under margin of clypeus minute and whitish. Punctation of head close, that of clypeus (except for broad impunctate margin of truncation) coarser than that of frons and vertex, that of lower parts of cheeks coarse and sparse; clypeal truncation somewhat concave, demarked by distinct angles, and conspicuously shorter than distance from its end to lateral angle of clypeus; cheeks slightly wider than eye seen from side; anterior ocellus much farther from antennal bases than from posterior margin of vertex; distance from a posterior ocellus to eye margin about equal to distance to posterior margin of vertex, distinctly greater than distance between posterior ocelli; mandibles stout, just over three times as long as shortest breadth, apex of median tooth about midway between apex of first and apex of third tooth; maxillary palpi four-segmented, second and third segments subequal and longer than others. Thorax a little less closely punctate than head, mesoscutum with punctures of same size as those of vertex, mesepisterna with punctures slightly larger; enclosure of propodeum roughened above; tegulae black or piceous; hind tibial spurs nearly straight; wings slightly dusky. Abdomen rather strongly punctured, punctures of center of second tergum separated by a little more than their diameters; posterior margins of terga feebly or not at all brownish, with distinct bands of white pubescence which are broken medially on first two or three segments; scopa white.

Male.—Length 6–7 mm. Similar in appearance to female; punctation of clypeus similar to that of frons and vertex; truncation of clypeus shorter (less than two-thirds as long as distance from its end to lateral angle of clypeus) than in female, and more strongly concave, with stronger angles at its ends; distance between posterior ocelli equal to (or slightly greater or less than) distance to posterior margin of vertex or eye margin; mandibles short and robust, outer tooth a little longer than inner. Mesocutum densely punctured and slightly more finely so than vertex. Sixth and seventh abdominal terga broadly rounded, the seventh visible only on dissection; second ster-

num rather large, with a short, median, apical emargination fringed with long hairs; longest hairs of genital coxopodites but little if any longer than width of coxopodite at subapical angle.

Type: female; Copeland Park, Boulder County, Colorado.

This is a widely distributed species, found from the coast of central and northern California to the Rocky Mountains. Colorado: Longs Peak Inn, 9000 feet elevation, June 30, 1926 (E. C. Van Dyke); Science Lodge, western Boulder County, July 20, 1939 (U. N. Lanham); four miles south of Grand Mesa, July 9, 1938 (R. Baner). Utah: Nephi, June 22, 1929 (E. G. Anderson). Oregon: Hanson's Resort, Jefferson County, July 29, 1929 (E. C. Van Dyke); Eagle Ridge, Klamath Lake, May 16, 1924 (C. L. Fox); Lake of Woods, Klamath County, 4950 feet elevation, August 11, 1935 (G. Ferguson). California: Mount Baldy, Panamint Mountains, Inyo County, June 19, 1937, on *Phacelia* (C. D. Michener); Argus Mountains, Inyo County, May 22, 1937 (N. W. Frazier); Independence Creek, Inyo County, 8000 feet elevation, June 17, 1937 (C. D. Michener); North Fork of Bishop Creek, Inyo County, 8500 feet elevation, June 22, 1937 (C. D. Michener); Mammoth Lake, Mono County, August 5, 1936 (G. E. and R. M. Bohart); Leavitt Meadows, Mono County, June 21, 1937; Truckee, June 13–21, 1927 (E. P. Van Duzee); Lake Tahoe, June 22, 1925 (E. H. Nast); Fallen Leaf Lake, Lake Tahoe, June 29, 1915 (E. C. Van Dyke); Gold Lake, Sierra County, August 4, 1921 (C. L. Fox); Shasta Springs, June 19, 1920 (C. L. Fox); Meadow Valley, Plumas County, 3500–4000 feet elevation, June 5–8, 1924 (E. C. Van Dyke); Big Flat, Coffee Creek, Trinity County, June 20, 1934 (G. E. Bohart); Sand dunes, San Francisco, June 25, 1925 (C. L. Fox).

Anthocopa (Hexosmia) arefacta (Cockerell)

Osmia arefacta COCKERELL, 1935, Pan-Pac. Ent., 11: 42.

Like the following form, this species is closely related to *copelandica*. From the description of the latter, it differs thus:

Female.—Clypeal truncation but little concave; distance between posterior ocelli usually greater than distance to nearest eye margin, slightly less than distance to posterior edge of vertex; tegulae rufotestaceous; abdomen rather finely and sparsely punctured, punctures of middorsal area of second tergum separated by about twice their diameters; posterior margins of abdominal terga rather broadly reddish.

Male.—Tegulae rufotestaceous; posterior margins of abdominal terga reddish; punctures of terga slightly finer than in *copelandica;* genital coxopodites with longer hairs nearly twice as long as width of coxopodites at subapical angle.

Type: Palm Springs, California, in the Timberlake collection at the Citrus Experiment Station of the University of California.

Thus far this species is known only from the eastern desert foot of the San Jacinto Mountains. A new locality is Andreas Canyon, near Palm Springs, California, on *Phacelia*, April 10, 1936 (C. D. Michener).

However, two male specimens from Lancaster, California, June 10, 1936 (G. E. and R. M. Bohart) seem intermediate between *arefacta* and

copelandica. The tegulae are but little darker than in *arefacta*, the posterior margins of the abdominal tergites are dark, and the hairs of the genital coxopodites are intermediate in length between those of *arefacta* and those of *copelandica*. These specimens possibly represent a new species.

Anthocopa (Hexosmia) albomarginata (Cockerell)

Osmia albomarginata COCKERELL, 1935, Pan-Pac. Ent., 11: 49.

This species is closely related to *A. copelandica*, from the description of which it differs only as follows:

Female.—Cheeks slightly narrower than eyes, seen from side; distance between posterior ocelli little if any less than distance to eye margin or to posterior margin of vertex; punctures of abdomen denser, those of middle of second tergum separated by much less than their diameters; posterior margins of terga not reddish.

Male.—Seemingly indistinguishable from *copelandica*.

Type: female; Swartout Valley, California, in Timberlake collection at the Citrus Experiment Station, University of California, Riverside, California.

This is a form of the mountains and coastal hills of southern California. It has been recorded from the Puente Hills. An additional locality is Tetley Park, San Bernardino Mountains, California, May 16, on *Nemophila* (C. D. Michener).

Subgenus **Phaeosmia,** n. subg.

Type species: *Osmia enceliae* Cockerell.

Black, without metallic reflections; eyes converging below in both sexes or subparallel in males; mandibles of male bidentate, of female tridentate and less than four times as long (measured along lower margin) as shortest breadth; trophi rather short, when folded reaching fore coxae, not provided with hooked hairs; first segment of labial palpus two-thirds or somewhat less than two-thirds as long as second. Longitudinal carina of inner ventral angle of posterior coxa strong. Scopa of female not unusually elongated; male with second sternum large and largely covering the third; sixth tergum of male with an obtuse or rounded angle at each side, seventh hidden or largely hidden by sixth, rounded posteriorly.

This subgenus, like *Eremosmia*, is primarily an inhabitant of desert areas although one species (*hemizoniae*) occurs in coastal southern California. The bidentate mandibles and nearly hidden seventh tergite in the male indicate a relationship with *Hexosmia*, from which *Phaeosmia* differs by its larger size, non-metallic integument, strong posterior coxal carinae, etc.

KEY TO SPECIES OF PHAEOSMIA

FEMALES

1. Clypeal truncation about two-thirds as long as distance from its end to lateral angles of clypeus; ends of truncation marked by distinct, although narrowly rounded, angles (p. 78) ..... **mortua**
Clypeal truncation about as long as distance from its end to lateral angles of clypeus; ends of truncation broadly rounded 2

2. Apex of clypeus gently emarginate between broad, gently rounded lobes which form the ends of truncation; scopa yellowish white (p. 79), **hemizoniae**
Apex of clypeus not or extremely slightly emarginate; scopa darker.....3
3. Distance between posterior ocelli equal to distance from a posterior ocellus to eye margin; anterior margin of clypeus directed forward, at distinct angle to lower disc of clypeus; scopa brown (p. 80).....**enceliae**
Distance between posterior ocelli conspicuously less than distance to eye margin; anterior margin of clypeus not strongly directed foreward; scopa pale ferruginous (p. 80).....**viguierae**

MALES

1. Inner ocular orbits converging to a point well below upper margin of clypeus (p. 80).....**enceliae**
Inner ocular orbits converging only down to a point opposite antennal bases, below which they diverge slightly (p. 78).....**mortua**

Anthocopa (Phaeosmia) mortua (Cockerell)

(Figs. 8 and 18)

Osmia viguierae var. *mortua* COCKERELL, 1935, Pan-Pac. Ent., 11: 44.

Although originally described as a variety of *viguierae*, this form is a distinct species as is amply shown by the characteristics of the previously undescribed female.

Female.—Length 7½–8 mm. Pubescence white, that of dorsum of head and thorax partly light fuscous, that of anterior margin of clypeus, that constituting short brushes under margin of clypeus and that which form a sparse subapical, outer tuft on each mandible orange. Punctation of head rather coarse and in most areas dense, sparser and coarser on area of vertex behind ocelli; truncation of clypeus straight or nearly so, markedly shorter than distance from its end to lateral angle of clypeus, angles demarking ends of truncation distinct, although rather narrowly rounded; anterior margin of clypeal truncation rather broadly impunctate, not directed foreward but in profile parallel to lower part of disc of clypeus; distance between posterior ocelli less than distance to eye margin and usually less than distance to posterior edge of vertex; anterior ocellus farther from antennal bases than from posterior edge of vertex; mandibles distinctly less than three times as long as shortest breadth, apex of second tooth nearer third than first tooth, subapical inner swelling strong and obtusely angulate; maxillary palpi four-segmented, second and third segments longest and subequal, first and fourth shorter. Thorax a little more coarsely punctate than most of head but not so coarsely so as posterior median part of vertex, punctures, even of mesepisterna, rather dense; upper part of enclosure of propodeum roughened; tegulae ferruginous; wings slightly dusky; posterior tibial spurs straight. Abdomen rather coarsely punctate, punctures of center of second tergum separated by more than their diameters, those of posterior margins of terga progressively finer and closer, no impunctate margins on terga; posterior margins of terga furnished with narrow but complete bands of white pubescence; scopa dull white.

Male.—Length nearly 6 mm. Similar in appearance to female. Inner ocular orbits subparallel, converging slightly toward antennal bases from both above and below; clypeus conspicuously more finely punctate than rest of head, anterior margin rather broadly impunctate,

truncation feebly crenulate, about five times as long as distance from its end to lateral angle of clypeus; area behind ocelli not more coarsely or sparsely punctate than rest of head; mandibles slightly narrowed at apices so that transverse breadth at apex of inner tooth is markedly less than breadth a short distance basad to that point; tegulae black with a reddish area; upper part of enclosure of propodeum smooth medially; sixth tergum with a rather narrow, posteriorly directed flange (which is sometimes brown) on the broadly rounded margin, sides of tergum each with a broadly rounded angle of varying prominence; second sternum rather large, narrowly subtruncate medially; third sternum broadly emarginate, emargination fringed with long hairs; fourth sternum broadly rounded posteriorly.

Type: male; Townsend Pass (or Emigrant Pass?) near Death Valley, Inyo County, California, 3000 feet elevation, in the Timberlake collection at the Citrus Experiment Station at Riverside, California. Additional specimens are from near Darwin Falls, Argus Mountains, Inyo County, May 30, 1937 (C. D. Michener); Wild Rose Canyon, Panamint Mountains, Inyo County, 3500 feet, May 28, 1937 (C. D. Michener); Mazourka Canyon, Inyo Mountains, Inyo County, May 25, 1937 (N. W. Frazier); Westgard Pass (west side), Inyo County, June 3, 1937 (E. C. Van Dyke), and same locality, June 15, 1937, on *Encelia farinosa* (C. D. Michener).

Anthocopa (Phaeosmia) hemizoniae (Cockerell)

Osmia hemizoniae COCKERELL, 1935, Pan-Pac. Ent., 11: 47.

This is the largest species of *Phaeosmia*, and differs from the others by the weakly bilobate condition of the margin of the clypeus.

Female.—Length 9 mm. Pubescence yellowish white, brushes under margin of clypeus and subapical brushes of mandibles reduced; punctation of head rather fine and dense, that of clypeus, except for the broad impunctate apical margin, coarser than that of frons and vertex; distance between posterior ocelli slightly less than distance to eye margin and distinctly less than distance to posterior edge of vertex; anterior ocellus about midway between antennal bases and posterior edge of vertex; truncation of clypeus not well demarked at ends, broadly rounded at each side, forming a median emargination; mandibles just over three times as long as shortest breadth, median tooth apparently equidistant between apices of first and third teeth. Thorax rather closely punctate, even on mesepisterna, and more coarsely so than head; enclosure of propodeum not roughened above medially; tegulae black with brown spot; wings slightly dusky; posterior tibial spurs straight. Abdomen strongly punctured, punctures of center of second tergum separated by less than their diameters; posterior margins of terga black, furnished with narrow bands of white hair, not impunctate but punctures finer than elsewhere on abdomen; scopa yellowish white.

Type: Riverside, California, in the Timberlake collection at the Citrus Experiment Station of the University of California at Riverside. Additional specimens are from Santa Monica, California, June 26, 1935 (E. G. Linsley).

Anthocopa (Phaeosmia) enceliae (Cockerell)

(Figs. 9 and 19)

Osmia enceliae COCKERELL, 1935, Pan-Pac. Ent., 11: 43.
Osmia viguierae COCKERELL, 1935, Pan-Pac. Ent., 11: 44. (♂, nec ♀.)

In its coarse punctation, this species resembles *mortua*, from which it differs in the black tegulae, more broadly truncate clypeus, etc.

Female.—Length 7–8 mm. Pubescence white, rather large brushes under margin of clypeus and tufts on outer surfaces of mandibles reddish; anterior ocellus farther from antennal bases than from posterior edge of vertex; distance between posterior ocelli equal to distance to eye margin, and to distance to posterior margin of vertex; punctation of head coarse and close, that of clypeus coarser than that of frons and most of vertex; anterior part of clypeus coarser than that of frons and most of vertex; anterior part of clypeus directed a little foreward, at a distinct angle to the somewhat receding lower part of disc; mandibles nearly four times as long as shortest breadth, middle tooth with apex about equidistant between apex of first and of third tooth, inner subapical swelling of mandible conspicuous but rounded; maxillary palpi four-segmented, second and third segments longest and subequal. Thorax coarsely and densely punctured, the mesoscutum more coarsely so than vertex; enclosure of propodeum not roughened medially above; tegulae black; wings slightly dusky; hind tibial spurs black and nearly straight. Abdomen strongly punctured, punctures of middorsal area of second tergum separated by more than their diameters; posterior margins of terga black, finely punctate, and furnished with narrow bands of white pubescence; scopa brown.

Male.—Length 7–8 mm. Similar in appearance to female. Punctation throughout finer than in the female; distance between posterior ocelli equal to distance to eye margin but less than distance to posterior edge of vertex; clypeus markedly more finely punctate than rest of head, the broadly impunctate and rather distinctly crenulate margin of truncation nearly four times as long as distance from end of truncation to lateral angle of clypeus; mandible but little narrowed at apex, width at tip of inner tooth but little less than width a short distance basad to this point. Abdomen with sixth tergum broadly rounded at apex, with a narrowly projecting brownish flange on the margin, and with a broadly rounded angle at each side; second sternum large, with feeble median apical emargination; third with broad apical emargination fringed with long hairs, fourth broadly rounded.

Type: female; Andreas Canyon, near Palm Springs, California, in the Timberlake collection at the Citrus Experiment Station, Riverside, California. A pair of topotypes were collected by the author, April 10, 1936, on *Encelia farinosa*.

Anthocopa (Phaeosmia) viguierae (Cockerell)

Osmia viguierae COCKERELL, 1935, Pan-Pac. Ent., 11: 44. (♀, nec ♂.)

Although this species and *enceliae* have been collected in the same locality and not elsewhere, they appear to be distinct but closely related forms. Males of but one species of *Phaeosmia* are known from this locality. While Cockerell placed them in *viguierae*, it seems probable, as

suggested to me by Mr. Timberlake, that they belong to the more common type of female, namely *enceliae*. Thus the true male of *viguierae* is unknown.

Female.—Similar to *enceliae* but more finely punctate, especially so on clypeus; anterior margin of clypeus but little directed foreward, nearly parallel with lower part of disc of clypeus; second mandibular tooth nearer to first than to third; distance between posterior ocelli conspicuously less than distance to eye margin or to posterior edge of vertex. Scopa pale ferruginous.

Type: Andreas Canyon, near Palm Springs, California, in the Timberlake collection at the Citrus Experiment Station, University of California, Riverside.

Subgenus **Xerosmia,** n. subg.

Type species: *Osmia xerophila* Cockerell.

Black, without metallic tints; eyes with inner margins converging below in both sexes; mandibles of male bidentate, of female tridentate, less than four times as long as shortest breadth; trophi short, when folded not reaching fore coxae, first segment of labial palpus about two-thirds as long as second, maxillary galeae and first two segments of labial palpi provided with numerous long hairs whose apices are hooked. Longitudinal carina of inner ventral angle of posterior coxa strong. Scopa of female not unusually elongated; male with second sternum not much enlarged, sixth tergum with a small tooth at each side, seventh tergum exposed and strongly tridentate.

Only the type species is placed with certainty in *Xerosmia*, although *A. palmarum* is included here tentatively, and in all probability correctly. This subgenus differs from all other *Anthocopa*, but resembles *Proteriades*, in the modifications of the mouthparts. These modifications are evidently associated with the flower visiting habits of these bees, their favored and only regular host being *Cryptantha*. It seems probable that *Proteriades* and *Xerosmia* are not closely related to one another, but that the similarity in mouth parts has arisen independently in the two groups.

KEY TO THE SPECIES OF XEROSMIA

FEMALES

1. Second mandibular tooth much nearer to first than to third tooth; distance between posterior ocelli greater than distance from one of them to eye margin (p. 83) ..... **palmarum**
   Second mandibular tooth about equidistant between first and third teeth; distance between posterior ocelli less than distance to eye margin (p. 81), **xerophila**

MALES

(Known only in *xerophila*.)

Anthocopa (**Xerosmia**) **xerophila** (Cockerell)

(Fig. 21)

Osmia xerophila COCKERELL, 1935, Pan-Pac. Ent., 11: 45.

Female.—Length 7½–8 mm. Pubescence dull white, that between white bands of dorsum of abdomen pale fuscous; brush arising

beneath margin of clypeus long, sparse, orange. Anterior margin of clypeus produced to a distinct, slightly concave truncation, shorter than distance from its end (which is angular) to lateral angle of clypeus; clypeus coarsely and not very closely punctate, margin of truncation impunctate; rest of head much more finely and closely pinctate; anterior ocellus farther from antennal bases than from posterior edge of vertex; distance between posterior ocelli less than distance to eye margin which is equal to distance to posterior edge of vertex; mandibles reddish subapically a little over three times as long (measured along lower margin) as shortest breadth, apex of middle tooth little if at all nearer to apex of first than to apex of the acute third tooth, inner subapical swelling feeble; maxillary palpi four-segmented, third segment longest, second and fourth subequal in length. Thorax with mesonotum finely and closely punctured like vertex, mesepisterna more coarsely and less closely punctured; enclosure of propodeum roughened above; tegulae rufotestaceous; apices of femora and bases and apices of tibiae narrowly reddish; hind tibial spurs nearly straight; wings slightly grayish, especially apically. Abdomen coarsely punctured, punctures of middle of second tergum separated by about their diameters; posterior margins of terga rather broadly reddish brown, and furnished with rather conspicuous bands of white pubescence; scopa brownish white.

Male.—Length 6½–9 mm. Similar in appearance to female but abdomen more elongate and parallel sided, the apex curled downward. Face rather densely covered with long, white pubescence; clypeus but little produced, its truncation nearly four times as long as distance from end of truncation to lateral angle of clypeus, margin of truncation broadly impunctate and weakly crenulate; clypeus otherwise fine and closely punctate; distance between posterior ocelli equal to distance to eye margin, slightly less than distance to posterior edge of vertex; antennae elongate, scape longer than mandible, flagellum slightly compressed, its segments, except for the penultimate one, longer than broad. Thorax similar to that of female; middle coxae each with a large, apical, ventral tooth directed posteriorly; carina of inner ventral angle of posterior coxae abruptly elevated in distal third. Abdomen with a small tooth at each side of sixth tergum; seventh tergum much exposed with a smooth transverse basal sulcus and three long apical teeth, the median one shorter and more slender than the slightly divergent, blunt pointed lateral ones, the lateral margin angulate beneath the bases of lateral teeth; first sternum with a large apical elevation, flattened on posterior face, summit slightly emarginate as seen from front or rear; second sternum not enlarged, feebly emarginate in middle of posterior margin; third and fourth sterna broadly emarginate and fringed with very long hairs; fifth sternum with a deep median emargination, the posterior margin laterad to emargination transverse; sixth sternum with a high longitudinal median keel, tapering anteriorly and ending in a sharp spine posteriorly.

Type: female; Palm Spring, Riverside County, California, in Timberlake collection at the Citrus Experiment Station of the University of

California at Riverside, California. Topotypes have been taken on March 22 (T. D. A. Cockerell) and April 16, 1939 (R. M. Bohart). The species is also known from Borego Valley. A number of specimens of both sexes have been reared by J. MacSwain from cells in old nests of *Anthophora linsleyi* Timberlake brought from Grape Vine Canyon (on the east side of the Sierra Nevada north of Walker Pass) Inyo County, California (G. E. Bohart).

Anthocopa (Xerosmia?) palmarum (Cockerell)

Osmia palmarum COCKERELL, 1935, Pan-Pac. Ent., 11: 48.

Although this species was described from at least three specimens, only the holotype is now in the Timberlake collection. The mouth parts of that specimen are retracted, and it has not seemed wise to extract them. The male is unknown. Therefore, the subgeneric position of this species has remained in doubt. However, its other structures suggest a possible relationship with *A. xerophila*, and the occurrence of *palmarum* on *Cryptantha* lends weight to the idea that it may be a *Xerosmia*. For these reasons it is placed tentatively in that subgenus.

Female.—Length 5–5.7 mm. Pubescence largely dull white. Inner margins of eyes subparallel; truncation of clypeus nearly straight, terminated laterally by distinct angles, truncation somewhat longer than distance from its end to lateral angle of clypeus; distance between posterior ocelli slightly greater than distance to posterior edge of vertex, which distance is greater than that to eye margin; mandibles reddish subapically, second tooth much nearer to first tooth than to third. Tegulae reddish; wings hyaline. Posterior margins of terga reddish; scopa white.

Type: Palm Springs, Riverside County, California, in the Timberlake Collection at the Citrus Experiment Station of the University of California, Riverside, California. The species is also known from 19 miles west of Kane Springs, California.

PART II

OLD WORLD SUBGENERA OF ANTHOCOPA

In this section only those subgenera of which I have seen specimens are discussed. The names *Acanthosmia* Thomson, *Arctosmia* Schmiedeknecht, *Aspidosmia* Brauns, *Lithosmia* Alfken, *Megalosmia* Schmiedeknecht, and *Protosmia* Ducke are based upon species which I have not seen, and some of which very likely belong to *Hoplitis* or *Osmia* rather than to *Anthocopa*.

Subgenus **Anthocopa** Lepeletier, s. str.

Anthocopa LEPELETIER, 1825, Ency. méth. (Ins.), 10: 314.
Type species: *Apis papaveris* Latreille (monobasic).
Phyllotoma DUMERIL, 1860, Mem. Acad. Sci. Paris, 31: 843. MICHENER, 1941, Amer. Midl. Nat., 26: 160.
Type species: *Apis papaveris* Latreille, by designation of Michener, 1941.

Furcosmia SCHMIEDEKNECHT, 1886, Apid. Europ., 2: 888. COCKERELL, 1922, Am. Mus. Novit., 40: 6.
Type species: *Apis papaveris* Latreille, by designation of Cockerell, 1922.
Pseudosmia RADOSZKOWSKI, 1872, Horae Soc. ent. Ross., 8: 18. COCKERELL, 1922, Am. Mus. Novit., 40: 6.
Pseudoosmia RADOSZKOWSKI, 1872, Bull. Soc. Moscou, 48: 152.
Pseudocosmia RADOSZKOWSKI, 1886, Horae Soc. ent. Ross., 20: 14.
Type species: *Megachile cristata* Fonscolombe, by designation of Cockerell, 1922.

This is a rather large, Old World group. It has much the appearance of the American *Atoposmia*, from which it differs by the clypeus of the female, which is broadly rounded or broadly truncate and not greatly produced over the base of the labrum, and by the form of the abdominal terga and sterna of the male. The mandibles of both sexes are tridentate, those of the female rather robust and about three times or less than three times as long as shortest breadth. The trophi are variable in length, in *A. papaveris* only reaching the fore coxae when folded, but in *A. crenulata* extending well behind the fore coxae. The inner ventral carina on each posterior coxa is weak or nearly absent. The sixth tergum of the male has a tooth at each side, and the seventh is exposed and furnished with two long lobes on its posterior margin. The sterna of the male are relatively simple, the second not or but little enlarged, the third clearly visible throughout its breadth and not or but little emarginate posteriorly.

In addition to the type species this subgenus includes *A. crenulata* (Morawitz), *longispina* (Perez), and to judge by the figures and descriptions alone, *A. saundersii* (Vachal), *dalmatica* (Morawitz), *bipartita* (Friese), etc. The female of *A. cristata* (Fonscolombe) is a remarkable form with peculiarly modified, quadridentate mandibles and with the clypeus provided with a great subapical transverse crest. It might well be placed in a distinct subgenus, for which the name *Pseudosmia* is available.

Subgenus **Glossosmia,** n. subg.

Type species: *Osmia singularis* Morawitz.

This subgenus resembles *Anthocopa* s. str. and *Atoposmia*, but differs from both by the bidentate mandibles of the male.

Mandibles of male bidentate, of female tridentate and more than three times as long as shortest breadth; clypeus of female truncate at apex and produced well over base of labrum; trophi elongated, when folded reaching far behind anterior coxae; carinae on inner ventral angles of posterior coxae practically absent; anterior face of first abdominal tergum broadly concave, separated from dorsal face by a distinct line formed by the termination of the smooth anterior surface of the tergum scopa of female (at least in type species) elongate as in many *Atoposmia;* sixth tergum of male with a tooth at each side, seventh (in type species) with an elevated, produced median area and a large broad tooth at each side; second sternum of male not much if at all enlarged, the third being visible throughout its breadth.

In addition to *A. singularis* (Morawitz), this subgenus apparently includes *A. anthocopoides* (Schenck) and *A. cypriaca* (Mavromoustakis), which differ, however, from the type species in the shorter clypeus and

scopa and more slender mandibles of the female and the produced and rounded seventh tergum of the male.

Subgenus **Erythrosmia** Schmiedeknecht

Erythrosmia SCHMIEDEKNECHT, 1886, Apid. Europ., 2: 886. COCKERELL, 1922, Am. Mus. Novit., 40: 6.
Type species: *Osmia andrenoides* Spinola, by designation of Cockerell, 1922.

This subgenus was originally described as a subgenus of *Osmia*, and separated from other groups of that genus primarily on the basis of the red abdomen.

The clypeus of the female is broadly rounded at the apex, much overhanging the base of the labrum. The mandibles of the male are bidentate, of the female tridentate and (in type species) nearly three times as long as shortest breadth. The trophi, when folded, easily reach the fore coxae. Each posterior coxa is furnished with a conspicuous longitudinal carina on its inner ventral angle. The sixth tergum of the male is without a transverse subapical keel and is not toothed laterally, the seventh is partly exposed and bidentate at the apex. The second sternum of the male is enlarged and not fringed posteriorly, the third is provided with a broad, fringed emargination.

This subgenus is apparently most closely related to the American subgenera *Hexosmia* and *Phaeosmia*. *Anthocopa sybarita* (Smith) (=*fossoria* Pérez) and *A. lhotelleriei* (Pérez) are best placed in *Erythrosmia*, although both lack red abdominal areas and have the mandibles of the female more slender than in *A. andrenoides*.

Subgenus **Rhodosmia** Michener, n. subg.

Type species: *Osmia paradoxa* Friese.

Only a single species has thus far been recognized as belonging to this subgenus. The small size and red abdomen suggest the type species of *Erythrosmia*, from which it may be immediately distinguished by the short clypeus and absence of the third mandibular tooth in the female, and by the hidden seventh and tridentate sixth terga of the male.

Mandibles of male bidentate, of female short, scarcely broader basally than at narrowest point, over three times as long as shortest breadth, apically furnished with two teeth close together near outer margin, followed by a nearly straight apical margin which extends to the inner apical angle; trophi when folded reaching anterior coxae; clypeus short, that of female but little overhanging base of labrum, broadly truncate, distance from end of truncation to lateral angle of clypeus but half as great as length of truncation; posterior coxae each with longitudinal carina on inner, ventral angle; first abdominal tergum with concavity of anterior face margined above by transverse carina; first sternum of male large, overhanging much of second and furnished with a great median tubercle, both first and second sterna emarginate posteriorly; seventh tergum of male entirely concealed, sixth turned under and furnished with three large, broad teeth on posterior margin.

Since certain of the characters of *Rhodosmia* agree with those given by Ducke for his group *Protosmia*, I here designate *Heriades glutinosus* Giraud as the type species of *Protosmia*. This is the first of Ducke's species, and is one which he figured. With its close relatives, it is abundantly distinct from *Rhodosmia* since the mandibles of the female, in *Protosmia* as thus restricted, bear a single outer apical tooth, followed by a series of peg-like processes along the apical margin, which is thus pectinate.

Subgenus **Hoplosmia** Thomson

Hoplosmia THOMSON, 1872, Skand. Hymen., 2: 233. MICHENER, 1941, Amer. Midl. Nat., 26: 161.

Type species: *Apis spinulosa* Kirby, by designation of Michener, 1941.

This group is easily distinguished from all the others by the produced and angulate or spined axillae. The males have an irregularly dentate transverse, subapical keel on the sixth abdominal tergite. The mandibles of the female are short and broad, scarcely narrowed medially, and but little more than twice as long as shortest breadth. The mandible of the male are bidentate. The posterior coxae are furnished with strong carinae on the inner ventral angles of each.

Several diverse types are included in this subgenus; some (e. g. *bidentata* (Morawitz) and *anceyi* (Pérez)) have long mouthparts as in *Atoposmia*, others (e. g. *spinulosa* (Kirby) and *ligurica* (Morawitz)) have short mouth parts. On the basis of this and other characters, *Hoplosmia* might be broken into several subgenera, but with specimens of only four species at hand, I hesitate to do this.

Subgenus **Othinosmia** Michener, n. subg.

Type species: *Thaumatosoma*[4] *moniliferum* Cockerell.

This is an African group which has a transverse, subapical keel on the sixth tergum of the male, suggesting a relationship with *Hoplosmia*, from which it differs by the edentate axillae.

Mandibles of male bidentate; clypeus not produced over base of labrum, its apical margin with truncation much broader than distance from end of truncation to lateral angle of clypeus; trophi without hammate bristles, when folded easily reaching fore coxae; antennae of male (at least in type species) elongate, flagellum compressed, especially distally, the apical segments constricted at each end so that they are oval in outline; legs slender; posterior coxae each with a longitudinal carina on inner ventral angle; first abdominal tergum with a shallow basal basin, bounded above by a weak carina; second sternum of male large, largely covering following ones, its posterior margin with an emargination fringed with long hairs; sixth tergum of male with a rather smooth subapical keel, similar in size and position to that of *Hoplosmia*.

Osmia calviniae Cockerell, of which I have not seen the male, very likely also belongs to *Othinosmia*.

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[4] *Thaumatosoma* is a little known Australian genus, probably in the Megachilinae.

NOTES ON ECUADORIAN BUTTERFLIES. III.

The Genus Lymanopoda Westwood (Satyridae)

F. MARTIN BROWN,
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As commonly considered this genus is composed of a very varied group of species. It does not bear with close scrutiny for congenerity. Three generic names have been proposed for members composing it since the recognition of the first species, described in (1851) in the "Genera of Diurnal Lepidoptera." At that time Westwood placed the three members in two genera which he subsequently combined under one of the names proposed, *Lymanopoda*. In this action all later students concurred. Although the species *samius*, type of *Lymanopoda*, is superficially quite different from *obsoleta*, the type of *Sarromia*, structurally they are sufficiently alike to be considered congeneric. They represent the extremes in a series of variations. In 1892 Roeber proposed the name *Trophonina* for Butler's species *acraeida*. While this separation might be held valid by some lepidopterists I am inclined to ignore it. This species is, to be sure, unlike the others in the genus—excepting *venosa* and *malia*, strictly congeneric with *acraeida*—yet the differences other than color pattern are quantitative rather than qualitative. I dislike subgeneric designations and so follow Weymer in placing both *Sarromia* and *Trophonina* as synonyms of *Lymanopoda*. Others will disagree with me on this point. That is their privilege. However, one entire group of species usually included in the genus *Lymanopoda* is quite evidently misplaced in that genus. Superficially they might be left there but structurally they are so distinct that I feel it is necessary to set them apart as a different genus. They have been excluded from this discussion and will be taken up in another paper.

Lymanopoda Westwood

(1851), Genera of Diurnal Lepidoptera 2: 401.
Genotype: *Lymanopoda samius* Doubleday & Hewitson.

Structures of the Head.—The eyes are lightly haired. The antenna is made up of 32 joints of which 11 or 12 form the club. The palpi are long, the second joint being longer than the combined first and third. They are clothed in long hair scales.

The Forelegs. — The prothoracic legs are strongly reduced. Although at least three joints are present, only one is visible to the unaided eye. They are deeply buried in long hair scales.

Venation of the Forewings.—The base of the radius is greatly swollen, of the cubitus moderately and the anal weakly so. The first and second radial branches originate before the end of the cell, the third well beyond it. The radius is five-branched. There is a

strong median stalk directed basad from the end of the cell. In *samius* and the blue species, the white group of species and *labda* and *ionius* of the brown species this stalk is posterior to the M_1; in all others it is anterior to that vein. A short cross vein is present between the radius and M_1.

Venation of the Hindwing.—The bases of the radius and cubitus are slightly swollen. The cross vein between M_1 and M_2 is long and sharply curved near M_1. M_3 lies only a little closer to Cu_1 than to M_2.

The Male Genitalia.—These structures are quite variable. The uncus is shorter than the tegumen. It may be simple as in *samius* or bifurcate. The sub-scaphium is more or less strongly chitinized. In some species it is very strongly so and pronged. The valves are generally small and equipped with a distal process and usually a dorsal one. These processes are toothed. The saccus is small. The aedaegus is long, rather heavy, more or less straight and sometimes spined or toothed.

The majority of the species of *Lymanopoda* (*sensu stricto*) are found in the temperate regions of the tropical forests of America. A few of them stray into the paramos and one or two may be restricted to those inhospitable regions. A few species are characteristic of the subtropical forests. Weymer recorded six species and forms from Ecuador in his resumé of the genus in Seitz' Macrolepidoptera of the World, V: 244–250. We have eleven from that country in our collections.

KEY TO THE SPECIES AND FORMS

1. Upperside: Forewings glistening blue with dark marginal markings..... 2
   Forewings brown, or white with dark markings (p. 90)..... 4
2. Underside: Forewing with a broad black discal zone flecked with blue scales and bearing some white spots.....**caerulata** Godman & Salvin
   Forewings ochraceous yellow with rusty markings and several white-pupilled dark spots..... 3
3. Upperside: A partial row of dark spots in the limbal area of the hindwing parallel with the margin.....**samius** Doubleday & Hewitson (1)
   The marginal dark band broad enough to engulf these spots,
   hazelana n. sp. (2)

THE SAMIUS GROUP

The type of the genus *Lymanopoda* Westwood belongs to this group of species. It is *samius* Doubleday and Hewitson.

1. **L. samius** Doubleday and Hewitson

(Fig. 1640, Pl. I)

(1851), Genera of Diurnal Lepidoptera, 2: pl. 67, f. 6 (*not* f. 7).

Type locality: Bogota, Colombia.

Range: Colombia (and Ecuador?).

Neither Whymper nor Stübel collected this species in the high mountains of Ecuador. Dognin reported it in collections made by the Abbé Gaujon in the old diocese of Loja (*Lepid. Loja et Env.*, p. 33, 1891). These specimens may well be the following new species. That part of Dognin's collection in the U. S. National Museum does not contain them. All of the specimens of *samius* that I have seen are from

Colombia where the insect seems to fly at moderately high altitudes in the central and eastern cordilleras. The genitalia of the male is figured (B1640) and may be recognized by the spur on the dorsal margin of the valves basad of the curved and toothed distal process, and by the teeth on the dorso-distal margin of the aedaeagus. Dr. A. Schultze-Rhonhoff has described a part of the life history of this species in *Iris* (43: 158).

2. **L. hazelana,** n. sp.
(Fig. 1623, Pl. I)

Type locality: Seville de Oro, Azuay, Ecuador, 2500 m., Feb. 15, 1939 (F. M. B.).[1]

Holotype: A male, no. B1623; deposited in the American Museum of Natural History.

Upperside.—The blue of this species is a little greenish when compared with *L. samius* D. & H. The dark margins are broad and contain fewer light spots than are found on that species, thus resembling to some extent *L. caeruleata* G. & S. The subapical blue spot is small and the three white specks marginal and caudad of it are inconspicuous. The broad dark margin of the hindwings is more uniform in width than that on *L. samius* D. & H. and there is no trace of the limbal black dots as such. A light powdering of bluish scales is evident through the middle of the dark band toward the anal angle.

Underside.—In general the coloring and pattern of this surface is the same as *L. samius* D. & H. and thus quite distinct from *L. caeruleata* G. & S. On the forewings the rusty markings across the cell are heavier on *hazelana* than on *samius*. All of the three subapical white species lack black margining scales and the three pupillated dark spots between the branches of the median, cubital and anal vein form a straight line and not an angle as in *samius*. On the hindwings the row of tiny black specks is situated about midway between the margin of the wing and the end of the cell. This row is parallel to the wing margin and thus differs from the similar row on *L. samius*, which is irregularly distant from the margin of the wing. At the base of the wing there is considerable dark scaling of a uniform character which is lacking from *L. samius*.

The male genitalia differ from those of *L. samius* D. & H. in several primary respects. The aedaeagus is free of teeth on the dorso-distal portion. The valves lack the spur anterior to the distal process on the dorsal margin. The distal process is curved less than 45° rather than 90° as in *L. samius*. The genitalia are figured (B1623, Pl. I). The genitalia of *L. caeruleata* are distinctly different. They are figured, B1684, Pl. I, and will be seen to be closer to *L. cinna* (B1674, Pl. I) than to either *samius* or *hazelana*.

[1]The stations noted are fully described and located in Brown, F. M., Ann. Ent. Soc. Amer., 34 (4): 809–851, 1941. The initials indicate the collectors, F. M. B. = F. M. & H. H. Brown; W. C.-M. = William Clarke-Macintyre; J. E. S. = J. Eugene Schilling.

The species is named for my wife who collected it among the stunted shrubs and *Chusquea* on the dry slopes of Cerro Negro above Seville de Oro.

KEY TO THE SPECIES AND FORMS
(Continued)

4. Upperside: White with darker markings 5
   The forewings brown, markings restricted to ocelli (p. 94) 14
5. Upperside: A broad dark bar extending from the costal margin to the outer margin of the forewings at least across the discocellulars; or apex dark to the cell 6
   No such bar ..... **galactea** Staudinger
6. Upperside: The dark bar (of 5) connecting with the outer margin 9
   This bar not connected with the outer margin 7
7. Underside: Hindwing light yellow ..... **lactea** Hewitson
   Hindwing whitish marked with rusty brown 8
8. Upperside: Dark markings blackish-brown 8A
   Dark markings rusty ..... **n. nivea f. sororcula** Thieme
8A. Upperside: hindwing with four distinct dark brown discal spots, **umbratilis f. leucotecta** Rosenberg & Talbot
   These spots lacking 8B
8B. Upperside: Hindwing with a marginal row of slender dark triangles on the nervules, nervules scaled with brown ..... **kruegeri** Roeber
   Hindwing without such markings ..... **nivea nivea** Staudinger (4)
9. Upperside: White of the forewings reduced to a subapical patch, **huilana** Weymer
   White more extended 9A
9A. Upperside: White restricted to a discal patch broadly bordered with black on the outer and costal margins and at the base; hindwings with broad black borders ..... **pieridina** Roeber
   White more extended 10
10. Upperside: Outer margin of the forewing with at least an apical white spot 11
   No white spots in the outer margin of the forewing ... **h. tolima** Weymer
11. Upperside: Cell of the forewing filled by the dark costal margin, **palumba** Thieme
   Some white in the cell of the forewing 12
12. Upperside: Dark bars along the R_s and Cu_a on the underside of the hindwing clearly visible from the upperside ..... **eubagioides?** Butler (3)
   Not so 13
13. Upperside: Dark markings blackish brown 13A
   Dark markings rusty ..... **n. melia f. sororcula** Thieme
13A. Upperside: Hindwing with a dark brown spot in the inner angle and brown dusting along the outer margin ..... **shefteli** Dyar
   Outer margin of hindwing lacking this brown marking .. **n. melia** Weymer

THE LACTEA GROUP

I have examined the male genitalia of six forms of the white *Lymanopoda* representing five species. They confirm the general opinion that these species are congeneric with the *samius* group and the dark species. The genitalia are quite variable, species to species, but within a species are rather stable. Subspecific differences occur but are always of a secondary nature. From the sampling of genitalia that I have studied these structures seem to offer a sound basis for the diagnosis of species in the genus. It is quite probable that a complete study will reduce some of the names held as species in the key to subspecific standing. Lack of material and the scope of this paper prevent such a study at this writing.

The armature of *L. galactea* Staudinger (B1639, Pl. I) is closer to that of *L. samius* D. & H. than that of any other of the white *Lymanopoda* that I have dissected. The structure of the genitalia of *L. huilana tolima* Weymer (B1638, Pl. I) and a species I believe to be *L. eubagioides* Butler (B1610, Pl. I) are similar but separable. The genitalia of *L. nivea* Staudinger (B1608, Pl. I) resembles the same structures of *L. ionius* W. & H. (B1636, Pl. I) and *L. labda* Hewitson (B1612, B1647, Pl. II). Thus the transition is made from the blue to the brown species through the white group.

The genitalia of *L. shefteli* Dyar (Fig. WDF., Pl. I) is very much like that of *L. galactea* Staudinger and the "species" may indeed be a form of that one. In 1914 Rosenberg & Talbot described a series of *Lymanopoda* from the Urubamba region of Peru under the name of *umbratilis*. These range from brown to white which the authors believe to be a single species. I have not seen these nor have they been figured. It may prove that *L. shefteli* Dyar and *L. umbratilis* f. *leucotecta* R. & T. are the same. They seem to be from the description. If this is the case the name of the species must be *shefteli* since it has some months priority. Dyar's paper was published July 22, 1913, while Rosenberg & Talbot's did not appear until March 31, 1914, although it appears in the Transactions of the Entomologist Society for 1913.

3. **L. eubagioides** Butler (?)

(Fig. 1610, Pl. I)

1873, Annals and Magazine of Natural History (4) 12: 220.

Type locality: Peru (Whitely).

Range: Peru, and Ecuador (?).

Ecuador: Hda. Talahua, Bolivar, 3100 m., April 29, 1939, 3 males (F. M. B.).

The three males that we took on the paramo of the western slope of the Andes are clearly not *nivea*. I assign them to this species with some doubt. I have no *bona fide* specimens of *eubagioides* for comparison. The male genitalia of my specimens (B1610) is easily recognized by the simple distal process on the valve and the bifurcate uncus. Some one with true *eubagioides* can easily verify or deny my identification.

4. **L. nivea nivea** Staudinger

(Fig. 1608, Pl. I)

1887, Exotische, Schmetterlinge 1: 232, pl. 83.

Type locality: "Quito," Ecuador.

Range: Probably from central Peru to central Colombia in the eastern cordillera.

Ecuador: Cerro Pasachoa, Pichincha, 3300 m., Nov. 12, 1938, 4 males, 1 female (F. M. B.). Minza Chica, Tungurahua, 3200 m., April 8, 1939, 5 males, 1 female (F. M. B.). Hda. San Rafael, Pichincha, 3000 m., Nov. 12, 1938, 1 male (F. M. B.). Pundoa, nr. Baños, Tungurahua, 2800 m., Dec. 1, 1938, 3 males (W. C.-M.).

This species was not collected in Ecuador by Whymper, Stübel or Gaujon (for Dognin). I cannot understand this unless we were particularly fortunate in arriving at the right places at the right time. All of our localities for this race are in the eastern Andes. The insects are never found far from *Chusquea*, the climbing bamboo. In this respect they differ from the preceding species. The Pundoa specimens were taken by David Laddey, one of Macintyre's collectors. The Pasachoa and San Rafael specimens are from the dry thickets at the upper margins of the grain fields and pastures of the hacienda San Rafael. The Minza Chica specimens were taken well within the temperate rain forest and are a little larger than the others.

4a. **L. nivea melia** Weymer

(Fig. 1609, Pl. I)

1912, Seitz' Gross-schmetterlinge der Erde 5: 245; pl. 52c3.

Type locality: Quindio Pass, Colombia, 3800 m., Sept.–Nov., 1939 (Fassl).

Range: Colombia and Ecuador in the western cordilleras.

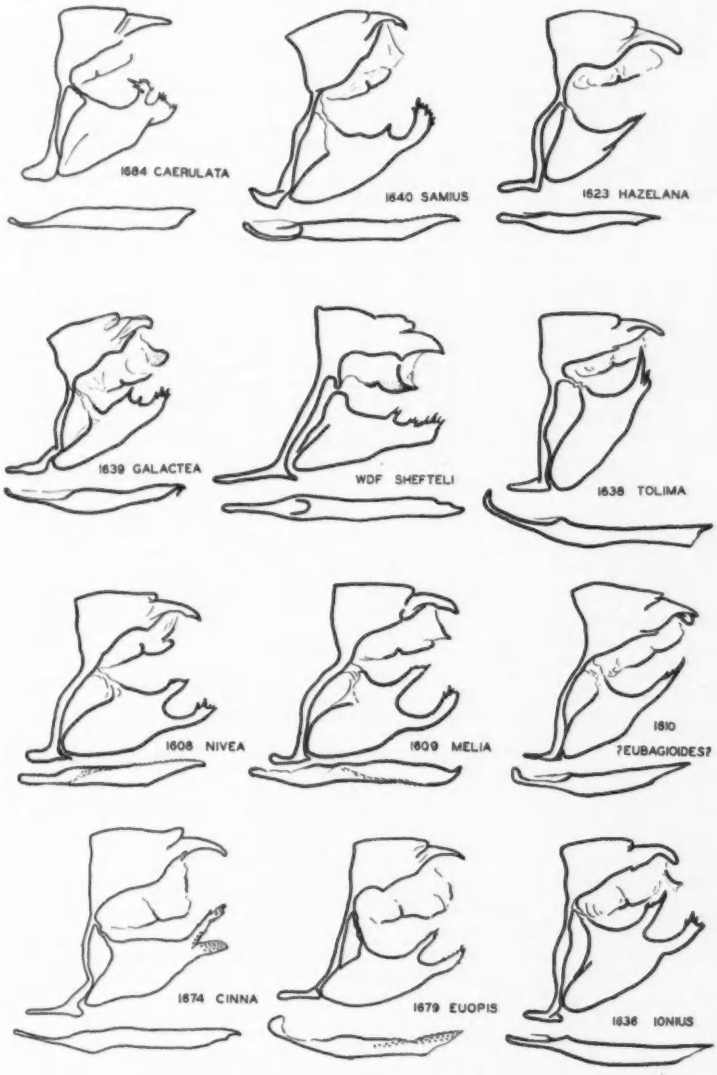
Ecuador: Hda. Talahua, Bolivar, 2900 m., May 5, 1939, 3 males (F. M. B.).

Our specimens were taken over *Chusquea* near the upper limit of a dense temperate rain forest. The genitalia (B1609) are practically inseparable from those of typical *nivea* (B1608).

In the *Berliner Entomologische Zeitschrift*, 49: 161, 1905, Thieme described *sororcula* from the "environs of Chimborazo" as a full species. Weymer treats this form as a race of *nivea*. I believe it to be a form which is common to both races, *nivea* and *melia*, but occurring infrequently at its fullest development. The females seem to be more susceptible to the rusty color replacing the black-brown than do the males. Until the type is examined and its racial affinity established it is best to consider the name a synonym of *nivea*. If it proves to be a form of *melia*, as I suspect from its type locality, the name *sororcula* must be used for the race in the western Andes as it has seven years priority.

The genitalia of the males of this species form the link with the following group of brown species. The dorsal spur of the valves is in this species developed into a full-fledged process bearing several teeth. The teeth on the aedaeagus readily distinguish it from *ionius* W. & H. and Ecuadorian *labda* Hewitson with which it might be confused solely on the basis of genitalia.

By far the majority of species of the genus are brown in color and constitute a part of the drably colored *Satyridae* that so few of the professional collectors bother to take. The following key to these may be helpful. It includes many species and forms that have not yet been recovered in Ecuador but I am sure that careful collecting will bring a number of them to light. This is especially true of the forms that haunt the temperate forests.



Genitalia of species of Lymanopoda Westwood.

KEY TO THE SPECIES AND FORMS
(Concluded)

14. Upperside: A large green or blue area on the hindwing....15
No such area....16
15. Upperside: Hindwing with an area of blue....**cinna** Godman & Salvin
Hindwing with an area of green....**marianna** Staudinger
16. Upperside: Marginal patches of reddish orange on the forewing....17
No such patches....19
17. Upperside: These patches restricted to the midsection of the outer margin, **venosa** Butler
A full marginal row of patches....18
18. Upperside: These patches absent from or forming only a partial row on the hindwing....**acraeida** Butler (11)
These patches forming full marginal rows on both wings....**malia** Godman
19. Underside: A white or whitish band, or broken band, or row of spots running diagonally across the hindwing from the anal margin to the inner angle (exclusive of white-pupilled black submarginal spots)....20
No such band or spots; or an orange band....24
20. Underside: A white or whitish transverse band on the hindwings, **altis** Weymer (8)
A white or whitish row of spots or a broken band on the hindwing....21
21. Underside: The white diagonal band on the hindwing slightly undulant, sometimes just broken on the veins....**albocincta** Hewitson (9)
This band a row of dots....22
22. Underside: The white diagonal dots are in a straight line, except the costal spot which is more basad; the pupillated spots of the forewing more or less uniformly small and in a straight line....23
The white spots do not form a straight line; the spots on the forewing irregular in size, the two nearest the inner angle are quite large, the line of spots is not straight....**affineola** Weymer
23. Upperside: A discrete row of minute reddish submarginal specks on the forewing....**apulia** Hopffer
No such marks, occasionally a white speck on the forewing, **albomaculata** Hewitson
24. Underside: An orange, toothed band extending from the anal angle to the inner margin....**Lymanopoda** (?) **levana** Godman
No such band present....25
25. Underside: A bluish or whitish elongate spot, often pearly, in the lower outer angle of the cell of the hindwing....26
This spot absent or of just a lighter shade of the ground color....32
26. Underside: The pearly silver spot in the cell forms the innermost spot of a series of three or four curving from the cell to the inner margin near the inner angle....**labda** ♂ Hewitson (5)
These spots between the cell and the inner margin lacking....27
27. Underside: The only other light spots on the hindwing are in a series parallel to the margin....27A
Other light spots present or the entire wing strongly mottled with dark scales....28
27A. Underside: A discal band of dark reddish-brown, narrowing to the inner margin and sending out a streak to the anal angle, **umbratilis** Rosenberg & Talbot
This band lacking....**labda** ♀ (5)
28. Underside: The ground color of the hindwing more or less uniform and a large light area extending from the M_2 to the Cu_2 inside of which is a series of whitish spots....**lebbaea** Felder
These light spots lacking....29
29. Upperside: On the hindwing the light spots of the underside are visible through the wing....**translucida** Weymer
The hindwings are opaque....30
30. Upperside: Forewing with a series of discrete whitish spots in the apex and along the outer margin....**hyagnis** Weymer
Lacking these spots....31

31. Underside: A broad blackish band along the outer margin of the forewing curved away from the apex where it is margined externally with whitish.....**rana** Weymer
Without this band.....**ferruginosa** Butler
32. Forewing: Outer margin well rounded with a slight reversed curve in the apex forming a slight apiculum.....33
Outer margin straight or smoothly curved.....34
33. Upperside: Five white spots on the forewing forming a curved line, or a narrow white band.....43
Two or less such spots.....33A
33A. Upperside: Two white spots on the forewing.....**obsoleta** ♀ Westwood (6)
At most only one minute, subapical white speck; base of the costa of the forewing rusty.....**confusa** n. sp. (7)
34. Upperside: At least four pupillated eye-spots on the outer margin of the forewing, two near the inner margin large.....35
These large eye-spots missing.....37
35. Upperside: The large eye-spots ringed with yellow, no spots on the hindwing.....**albocincta** ♀ Hewitson
The large eye-spots not ringed with yellow.....36
36. Underside: A row of eye-spots on the hindwing.....**gortyna** Weymer
No eye-spots on the hindwing.....**panacea** f. **gortynoides** Weymer
37. Hingwing: Outer margin toothed.....**Lymanopoda (?) maso** Godman
Outer margin smooth or at most undulate.....38
38. Underside: Base of the forewing much lighter than the outer half, except the apex.....**ionius** Westwood
Base of the forewing no lighter and often darker than the outer half.....39
39. Upperside: Five large dark eye-spots on the forewing.....42
Forewings without markings or with small obscure spots rarely more than three in number.....40
40. Underside: Distinct marginal row of white spots on both wings, none of the spots on the forewing broadly ringed with black.....**caucana** Weymer
Two of the posterior spots on the forewing broadly ringed with black....41
No such spots.....**obsoleta** Westwood (6)
41. Underside: The small black submarginal spots on the hindwing ringed with bright reddish brown and often with white pupils,
panacea Hewitson (10)
These spots usually with white pupils but without the reddish rings,
venusia Hopffer
42. Upperside: Hindwing with at least five large dark spots more or less paralleling the outer margin.....**euopis** Godman & Salvin
Hindwing with rarely more than one dark spot near the margin,
marica Weymer
43. Hindwing: A blunt tail, 3 mm. long at "vein 4,"
Lymanopoda (?) caudalis Rosenberg & Talbot
Not tailed.....**excisa** & ff.

I am not familiar with *L. nevada* Krueger (*Ent. Rdsh.*, 41: 7, 1924). This species may replace either *L. kruegeri* or *L. pieridina* of Roeber.

Note: *Lymanopoda varola* Schaus = *Manerebia cyclopina* Staudinger, *Lymanopoda villarresi* Dognin = *Euptychia villarresi* (Dognin), *Lymanopoda levana* Godman, *maso* Godman and possibly *caudalis* R. & T. may be out of place in this genus. I have not had the opportunity to examine them.

THE CINNA GROUP

This group of three species, *cinna* Godman & Salvin, *marianna* Staudinger and *euopis* Godman & Salvin, is not represented in collections from Ecuador and I doubt very much if it occurs there. It is distinctly aberrant in coloration and although the genitalia of *cinna*

(B1674) indicate that the species belongs to this genus the arrangement of the distal and dorsal processes on the valves is unusual as will be seen from the figure given. The genitalia of ***euopis*** (Fig. B1679, Pl. I) are more normal and resembles those of ***nivea***. With this species we have a transitional stage in the development of the pattern toward the ***obsoleta*** group.

THE LABDA GROUP

5. **L. labda** Hewitson

(Figs. 1612 and 1647, Pl. II)

1861, The Journal of Entomology 1: 157; pl. 9, f. 4.

Type locality: Colombia.

Range: Colombia, Ecuador and Peru.

Ecuador: Runtún, nr. Baños, Tungurahua, 2800 m., Nov. 22, 1938, 2 males, (F. M. B.); 2500 m., Dec. 17, 1938, 1 male, (F. M. B.). Baños, Tungurahua, 1900 m., Oct. 22, 1939, 1 male, (W. C.-M.). Rio Ulva, nr. Baños, Tungurahua, 2500 m., Feb., 1939, 1 male, (J. E. S.); 1900 m., May 14, 1939, 1 male (W. C.-M.). Rio Blanco, nr. Baños, Tungurahua, 1800 m., April 5, 1939, 10 males (W. C.-M.); Yungilla, nr. Baños, Tungurahua, 1800 m., April 21, 1939, one male, (W. C.-M.).

The Rio Blanco and Yungilla specimens taken by Macintyre's native collectors probably came from much higher up the valley. I have a dozen or so species with these same data that we found nowhere under 2500 m. on the eastern slopes of the Andes. Dognin reported the species among those shipped him from the "environs of Loja." Neither Whymper nor Stübel collected the species.

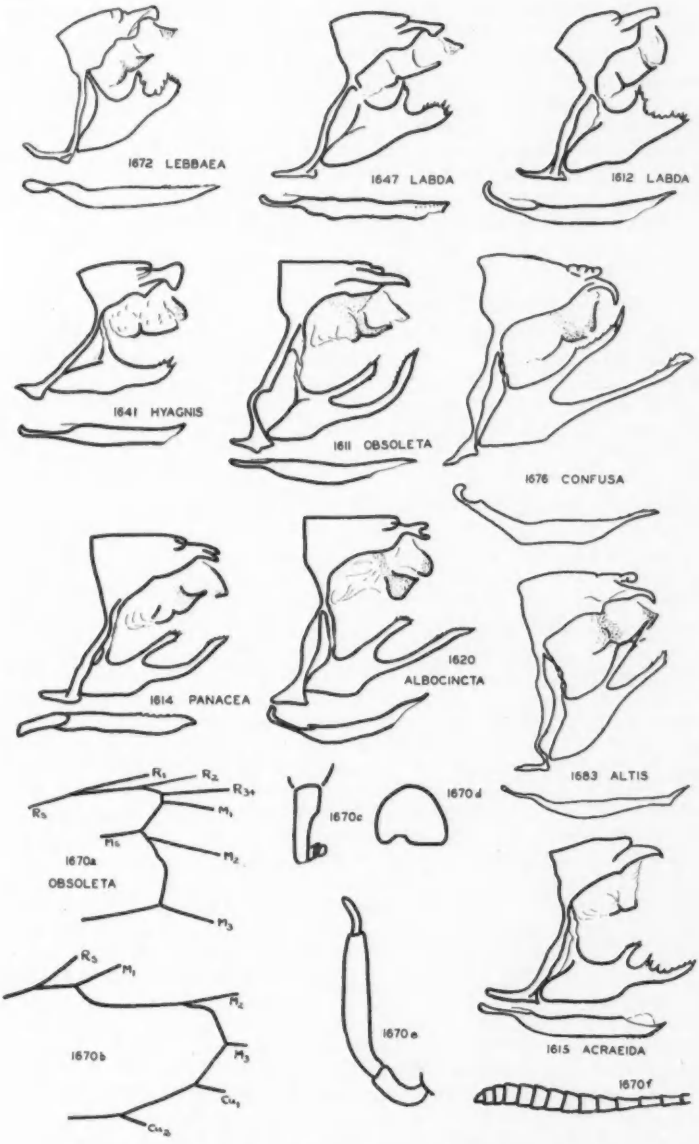
We found this species, like ***nivea***, around ***Chusquea***.

The male genitalia (B1612) may be recognized by the blunt tip on the uncus and the strongly toothed dorsal and distal processes on the valves. Colombian specimens (B1647) show a greater extension of the teeth in the "saddle" between the valvular processes then do the Ecuadorian specimens. This difference is supported by more extensive clear pearly white markings on the underside of the hindwings. The Peruvian specimens that I have seen have a much lighter ground color on the underside. I do not feel the need for designating these slightly differentiated choromorphs, since there is no possibility of confusing them with another species.

To this group I would assign the following species which have not as yet been found in Ecuador:

L. lebbaea Felder (B1672), (Fig. 1672, Pl. II). The male genitalia are very much like those of ***labda***. In fact so much so that I would hesitate to separate the two species by that means alone. It might be best to consider it as a race of ***labda***. The light colored specimens of this species from Peru approach ***lebbaea*** but are separable from it on the characters used in the above key, i. e., the isolation of the cellular pearly spot on the hindwing of ***lebbaea***.

L. ionius Westwood (B1636), (Fig. 1636, Pl. I) is a species from the upper subtropical regions in Colombia that is quite distinct from ***labda*** in markings but close to it in the form of the male genitalia. Weymer's species ***excisa*** may be a form of this species.



Genitalia and other parts of species of Lymanopoda Westwood.

L. ferruginosa Butler from Bolivia and Peru is quite variable. Three subspecific names have been applied to it, ***translucida***, ***hyagnis*** (B1641), and ***rana***, by Weymer in Seitz' (5: 247). These are apparently tenable names from the specimens I have examined. However I would hesitate to designate the first two as racial. They, I feel, are forms of ***ferruginosa*** while ***rana*** appears to be a good race. The genitalia of all are so much alike as to be inseparable. These structures resemble those of ***labda*** in the form of the tegumen and uncus and ***tolima*** as to valves. Thus as far as these structures are concerned the species links the white and brown groups of the typical ***Lymanopoda***.

THE OBSOLETA GROUP

(1851), *Sarromia* Westwood, Genera Diurnal Lepid. 2: 402.

The species that constitute this group may be readily recognized by the peculiarities of the male genitalia. Although the general plan of these structures place the species in the genus ***Lymanopoda***, the great length of the valvular processes and the heavy chitinization of the subscaphium set them apart. The wing shape of some of the forms is abberant. I have not examined ***excisa*** Weymer which may belong among these insects, but as I have stated above, I am inclined to feel that it is very closely allied to ***ionius*** Westwood.

6. **L. obsoleta** Westwood and Hewitson

(Figs. 1611 and 1670 a-f, Pl. II)

(1851), Genera of Diurnal Lepidoptera, 2: pl. 67, f. 5, p. 402.

Type locality: Bolivia.

Synonym: ***larunda*** Hopffer, ***Stettiner entomologische Zeitung***, 1874: 361; ***larumna*** Staudinger, ***Iris***, 7: 72, 1894.

Range: Venezuela to Bolivia, in the mountains and higher foothills.

Ecuador: Runtún, nr. Baños, Tungurahua, 2800 m., Nov. 22, 1938, 4 males (F. M. B.); 2100 m., Nov. 26, 1938, 2 males (F. M. B.); 2000 m., Dec. 17, 1938, 3 males (F. M. B.); Feb. 27, 1939, 1 female (W. C.-M); Oct., 1938, 1 male (W. C.-M); 1900 m., Nov. 28, 1938, 1 male (F. M. B.). Pundoa, nr. Baños, Tungurahua, 2300 m., Dec. 1, 1938, 3 males (W. C.-M). Rio Blanco, nr. Baños, Tungurahua, 2000 m., Oct. 18, 1938, 1 male (W. C.-M.); 1900 m., May 5, 1939, 2 males (W. C.-M). Baños, Tungurahua, 2000 m., Jan., 1939, 4 males (J. E. S.); 2300 m., May 13, 1939, 1 male (W. C.-M); Feb., 1939, 8 males, 1 female (J. E. S.); 1900 m., June 12, 1939, 1 male (W. C.-M.). Yungilla, nr. Baños, Tungurahua, 1700 m., May 27 and June 2, 1938, 2 males (W. C.-M.).

Weymer reported a specimen among Stübel's catch. It was taken at Pullulaga, north of Quito in the western cordillera at an altitude between 2500 and 2700 meters and between the 9th and 28th of July in 1873. Dognin reported the species as ***larunda*** among those collected by Gaujon in the Loja region. Whymper did not take it.

This is another of the species that haunts the ***Chusquea*** thickets. It is found from the upper levels of the sub-tropical humid forest to the edge of the paramo. It seems to be much more common in the lower part of its range than the upper. There are occasional ***Chusquea*** thickets as low as 1400 m. in the valley of the Pastaza, but so far no

specimens have been turned up lower than 1700 m. The Baños specimens collected by Schilling (J. E. S.) were doubtless caught on Runtún. Those he collected in January he labelled from 2000 m., the February material bore no altitude note but probably came from the same place.

The species is the type of the genus *Sarromia* Westwood. When the immature stages are known it might be expedient to resurrect this genus. The species, ***obsoleta***, is not strictly congeneric with ***samius*** D. & H., but is sufficiently close to allow the present arrangement to stand. The generally studied structures such as venation are like those of ***samius*** D. & H. These, of ***obsoleta*** W. & H. are figured B1670a-f.

7. **L. confusa** n. sp.

(Fig. 1676, Pl. II)

Type locality: "Ecuador."

Range: Colombia and Ecuador.

Holotype: a male, (B1676), ex coll. Frank Johnson "Ecuador."

Paratypes: No. 1, a male, ex coll. Dognin, Loja, Ecuad., June, 1886. No. 2, a male, ex coll. E. T. Owen, locality undecipherable. The preceding three specimens are in the U. S. National Museum. No. 3, a male, Choachi, Colombia, March, 1914, Acc. no. 5430, Carnegie Museum.

This species is very easily confused with ***obsoleta*** under which name it may be masquerading in other collections. In two easily observed minor ways it differs from ***obsoleta***—the apex of the forewing is strongly falcate and terminates in a sharp point and the basad portion of the costal margin and the costad portion of the base of the forewings is bright rusty brown in contrast with the general dull brown of the upper surfaces.

The male genitalia (B1676) differ more from those organs of ***obsoleta*** (B1611) than do the male genitalia of ***albocincta*** (B1620) or ***panacea*** (B1614) differ from those of ***obsoleta***. The most striking difference is to be found in the dorsal process of the valves. In ***obsoleta*** it is barely half as long as the distal process. In ***confusa*** it is almost as long as the distal process. The aedaeagus of ***obsoleta*** is free of distal spines while that of ***confusa*** bears a distinct disto-dorsal row of them.

The determination of this species can only be made certain by dissection unless the genitalia are protruding and can be examined. If after the present European conflagration the type of Hopffer's ***larunda*** is still extant in the Zoological Museum of the University of Berlin it will be possible to examine the genitalia of that insect and prove whether or not it is a synonym of ***obsoleta*** or this new species is a synonym of ***larunda***.

8. **L. altis** Weymer

(Fig. 1683, Pl. II)

1890, Stübel's Reise, Lepidoptera, p. 41 and 109, pl. 3, f. 8.

Type locality: Paramo de Aponte, 2800 m., Nov. 25 to Dec. 11, 1869, So. Colombia.

Range: Colombia and Ecuador.

Ecuador: Runtún, nr. Baños, Tungurahua, 3000 m., Jan. 9, 1939, 4 males (W. C.-M.).

This species which Weymer described from material collected by Stübel in Colombia and Ecuador is placed by him in Seitz' close to "*L.*" *leaena*. It is far removed from that species and is a member of this group of *Lymanopoda*. I was unsuccessful in my search for it but while I was on the Rio Upano, David Laddey, one of Macintyre's collectors, turned up the four specimens in my collection. They were taken close to the limit of trees among *Chusquea* on the northeast shoulder of the Volcano Tungurahua. The genitalia of the male (B1683) are easily recognized by the great length of the dorsal process on the valves. This process exceeds the distal in length in this species.

9. **L. albocincta** Hewitson
(Fig. 1620, Pl. II)

1861, The Journal of Entomology, 1: 157; pl. 9, f. 5.

Type Locality: Colombia.

Range: Colombia and Ecuador.

Ecuador: Balzapamba, Bolivar, 700 m., May, 1938, 1 male (W. C.-M.). Rio Toachi, Pichincha, 800 m., Nov., 1939, a male (W. C.-M.).

There is some discrepancy between the data on the specimens procured for me by Macintyre and the specimens I have seen from Colombia. The Colombian specimens are from altitudes that indicate that the species inhabits the cool upper reaches of the temperate forest. The data on the paper triangles in which my specimens arrived from Macintyre would indicate that the species was a denizen of the humid tropical jungle. The data on the Balzapamba specimens are probably correct. Macintyre and his crew were working that region at that time. The Rio Toachi specimen was from a lot purchased by Macintyre from a bird collector—one of the Olalla's?—in Quito. It contained a miscellaneous group of species, some of which are confined to the humid tropics and may well have been collected at Rio Toachi, 800 m., but others among it are restricted to the semi-arid paramos of the interandean plateau 2000 meters higher in altitude. So that the specimen here noted may have come from an altitude between 800 and 2800 meters on the western slope of the western cordillera. Thus the Rio Toachi data cannot be accepted at their face value. Dognin reported the species among those collected by Gaujon in "the environs of Loja." Four of Dognin's specimens are in the U. S. National Museum. Three are from "Loja" and one from "Zamora." As I have already stated, that means somewhere in southern Ecuador and not much more! It may have been taken high or low, on the east slope or the west, in dry or humid lands. Stübel did not collect this species in Ecuador. Coxey took a specimen at "Yungilla, nr. Baños, 4000 ft., March, 1930." This is the only reliable east slope record of which I have knowledge. Ecuadorian specimens differ slightly from those from Colombia in the width of the white spots on the underside of the hindwings.

Although the form of the wings and the general pattern of this species are quite distinct from *obsoleta*, the genitalia of the two species are much the same as are the other structures of the insects. The differences to be found in the genitalia are minor, and the uncus of *albo-*

cincta is bifurcate setting the species apart from *obsoleta* and the aedaeagus is free of teeth differentiating it from *panacea* and *albomaculata*.

10. **L. panacea** Hewitson

(Fig. 1614, Pl. II)

1869, Equatorial Lepidoptera, p. 35.

Type locality: "Ecuador."

Range: Colombia to Peru.

Ecuador: Chinchin Grande, Tungurahua, 1400 m., Oct., 1939, 1 male (J. E. S.). Abitagua, Napo-Pastaza, 1300 m., May 26, 1939, 1 male (W. C.-M.); June 2, 1939, 1 male (W. C.-M.). La Palmera, Tungurahua, 1300 m., Dec. 10–12, 1938, 3 males (W. C.-M.). Hda. San Francisco, Tungurahua, 1250 m., Sept. 20–24, 1938, 7 males (F. M. B); Dec. 1, 1938, 2 males (F. M. B.); Jan. 28, 1939, one male (W. C.-M); Mar. 7, 1939, a male (F. M. B.). Rio Margarjitas, Tungurahua, 1250 m., Mar. 19–23, 1939, 7 males (F. M. B.). Rio Topo, Napo-Pastaza, 1150 m., Sept. 30, 1938, one male (F. M. B.); Dec. 1, 1938, 1 male (F. M. B.). Rio Abonica, Santiago-Zamora, 1000 m., Jan. 21, 1939, 3 males (F. M. B.).

Hewitson's type was collected by Buckley, probably along the Baños-Canelos trail down the Rio Pastaza in the vicinity of the present Hda. San Francisco. Although Weymer did not report the species among Stübel's Ecuadorian material he gives Huamboya as a locality for it in Seitz' (p. 250). To my knowledge all Huamboya material was brought out by Stübel who purchased it from a native collector in Riobamba. Stübel's note regarding the locality is vague. Huamboya is the name given the ridge and general region lying east of Cerro Altar which is in turn east of Riobamba. Weymer's "Riobamba" specimens were doubtlessly collected by Feyer who thus dubbed many things that he caught along the Pastaza as he journeyed from the tropical forests to the arid temperate uplands that surround Riobamba. It is possible that Feyer collected the "Huamboya" specimen. The normal habitat of *panacea* is the subtropical humid forest.

I have carefully examined the male genitalia of *panacea* (B1614), *venusia*, *apulia*, *affineola* and *albomaculata* and find that there is no way to separate them. Thus I am led to believe that these forms along with *marica* and *caucana* represent a complex composed of one biological species. However, until this complex is more clearly understood it will probably be better to consider it to represent two taxonomic species—*panacea* and *albomaculata*. I believe that ultimately these two "species" will be considered races and the other named forms noted above will be either junked or considered local forms of a single species. I do not have the material to make a further study.

THE ACRAEIDA GROUP

1892, *Trophonina* Roeber, Schatz & Roeber, *Die Fam. und Gattungen der Tagfalter*, p. 222, no 66.

There are two species in this group, *acraeida* Butler and *venosa* Butler. The former is found in Ecuador. Along with it occur occasional specimens that tend toward the Peruvian race *malia* Godman.

I have not examined the male genitalia of *venosa* and it may prove to be another race or form of *acraeida* thus reducing this group to a single species.

11. **L. acraeida** Butler
(Fig. 1615, Pl. II)

1868, Catalogue of the Satyridae, British Museum, p. 171, pl. 4, f. 6.

Type locality: Bolivia.

Range: Bolivia to Ecuador.

Ecuador: Hda. San Francisco, Tungurahua, 1300 m., Sept. 20–28, 1938, 9 males (F. M. B.). Rio Mapoto, Tungurahua, 1200 m., Jan. 30, 1939, one male (W. C.-M.). Hda. Sta. Ines, Tungurahua, 1200 m., Mar. 22, 1939, one male (F. M. B.). Rio Topo, Napo-Pastaza, 1226 m., July 15, 1936, 5 males (W. C.-M.); Sept. 30, 1938, 3 males (F. M. B.); Dec. 1, 1938, 1 male (F. M. B.); Dec. 17, 1938, 3 males (F. M. B.). Hda. La Palmera, Tungurahua, "1000 m.," Dec. 11, 1938, 1 male (W. C.-M.). Bet. Rio Abonica and Macas, Santiago-Zamora, 1100 m., Jan. 21, 1939, 2 males (F. M. B.).

The altitude given above for Hda. La Palmera is about 200 m. too low. The station is above the junction of the Rio Topo with the Rio Pastaza on the south side of the larger stream. The elevation of the junction is close to 1200 m. The region where this species abounds lies in the lower part of the humid subtropical forest in the foothills. My series of specimens show many indications of the reddish brown spots on the margins of the hindwings, in no case, however, are the spots well defined or is there a complete series of them such as is found on the race *malia* Godman from Peru.

Roeber erected the genus *Trophonina* for this species. The superficial aspects are quite striking but that is insufficient for separating it from *Lymanopoda*. The venation at the end of the cell of the forewing does not differ from the usual type found among the brown species in the genus and figured (1670 a). The male genitalia are easily recognized but are basically like those of the other species of the genus. The long distal process is straight and strongly toothed along the dorsal margin. The dorsal process is short and finely toothed. The aedaeagus is toothed on the dorso-distal region. The sub-scaphium is less strongly chitinized than in the preceding species but is more lightly than in the typical species like *samius* and *ionius*. The saccus is proportionately a little longer than usual. The uncus is simple.

I wish to express my thanks to Mr. William P. Comstock of the American Museum of Natural History, Dr. William D. Field of the U. S. National Museum, J. W. Cadbury, 3rd, of the Academy of Natural Sciences, Philadelphia, and Dr. A. A. Avinoff of the Carnegie Museum, for lending me materials in their care. Dr. Field also dissected *L. shefteli* Dyar for me and sent me drawings of these organs from which I drew the figure used.

NEW SPECIES OF CRANE-FLIES FROM SOUTH AMERICA PART X.[1] (Tipulidae: Diptera)

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In the present paper I wish to discuss a series of unusually interesting crane-flies that were taken at Abitagua, Oriente, Ecuador, by Mr. William Clarke-MacIntyre and his assistants of the Velastegui family, especially Miss Rosario Velastegui. Since Mount Abitagua has been mentioned frequently in the past and is certain to be of considerable importance in the future, it seems advisable to supply a few facts of interest to entomologists.

Richard Spruce (Notes of a Botanist on the Amazon and Andes; 1908) thrice mentions Abitagua. His account of the mountain as he found it on the occasion of his memorable trip in 1857 is as follows:

"The cryptogamic vegetation of some parts of the Montaña of Canelos is wonderful. There is one mountain, called Abitagua, which though not more perhaps than 5,000 feet high, is continually enveloped in mists and rains. The trees on it, even to the topmost leaves, are so thickly encased in mosses that a recognizable specimen of them would be scarcely procurable, if indeed they ever flower, which must be very rarely."—Spruce, 2: 177.

"Perhaps never a day passes without rain on this mountain, and its summit is nearly always enveloped in mist, which looks as if it were permanently hung up in the trees. The trunks and branches of the latter, and often even the uppermost leaves, are densely enveloped in mosses. Various species of *Plagiochila*, *Mastigobryum*, *Phyllogonium*, *Bryopteris*, etc., hang from the branches to the length of one to three feet, and in such thick bunches that when saturated with rain they often break off even green branches by their weight. I have been told by the cargueros of Baños that when they pass with cargoes through the most mossy parts of the Montaña after much rain has fallen they step with constant dread of being crushed by some ruptured branch."—Spruce, 2: 147.

In recent years, Mount Abitagua has been purchased by Mr. MacIntyre and the most desirable portions of the area belong to him. The following further brief account is of interest. "I think that the reason why material from Abitagua is so ample and diverse is on account of the fact that it lies in a hollow, in a cove of the Pastaza, one-half mile to the west and one-half mile to the east; the altitude is around 1,200 meters. Right here at my house it is only 1,050 and down on the beach of the river only 1,000 meters. My house is on a bench of land; directly in front of me, to the north, the hills rise gradually to nearly 2,000 meters and in back of the house it is a 50-meter climb down to

[1]Contribution from the Entomological Laboratory, Massachusetts State College. The preceding part under this general title was published in the Annals of the Entomological Society of America, 34: 231–254, 1941.

the river. Sometimes I collect in the banana groves, sometimes on a path through the woods up the hills, sometimes down along the river. Sometimes I climb up the course of one of the small mountain creeks,—there are six of them on my property,—viz., the Bella Vista, La Industria, The Fox, La Guillermina, La Eloisa, and El Eugaño. When next I collect Tipulidae I will label them carefully as to exact location and will send on a sketch map."—MacIntyre, *in litt.*, 1940.

The types of the novelties described herewith are preserved in my extensive collection of these flies.

Tanypremna Osten Sacken

Tanypremna (Pehlkea) regulus sp. n.

General coloration of notum dark brown, the praescutum with indications of more reddish stripes; pleura yellow with a narrow black transverse girdle; femora and tibiae black, the latter with a narrow white ring at base; tarsi white; wings yellowish cream color, very heavily patterned with brown; male hypopygium with the tergal lobes obtusely rounded; outer dististyle strongly narrowed outwardly; inner dististyle with a conspicuous quadrate lobe on inner basal portion, the long slender rostrum shallowly emarginate at apex.

Male.—Length about 22 mm.; wing, 17 mm.

Female.—Length, about 24 mm.; wing, 16.5 mm.

Frontal prolongation of head very short, yellow, with a long conspicuous blackened nasus, the apex of prolongation surrounding base of nasus strongly darkened; mouthparts black; palpi dark brown to black. Antennae short; scape yellow; pedicel brown; flagellum black. Front and anterior vertex light yellow, the posterior vertex and occiput abruptly dark brown; anterior vertex relatively wide, of about equal width in both sexes, approximately four times the diameter of the scape.

Pronotum testaceous yellow. Mesonotum almost uniformly dark brown, the praescutum behind with indications of more reddish brown stripes; centers of scutal lobes similarly reddened. Pleura yellow with a conspicuous black transverse girdle, extending from before the suture across the dorsopleural region, including the entire posterior half of mesepisternum, somewhat paler on the cephalic portion of the anepisternum and sternopleurite, the girdle further involving the mid-coxae. Halteres elongate, greenish yellow, knobs weakly darkened. Legs with the coxae yellow; trochanters greenish yellow; femora black, slightly paler on basal portion; tibiae black with a narrow but distinct greenish white basal ring; tarsi uniformly white. Wings with the ground color of disk yellowish cream, very heavily patterned with brown, including a postarcular area; a major darkening centering at the supernumerary crossvein in cell *M*, extending from veins *R* to *Cu;* cord and outer end of cell *1st* M_2 very extensively clouded, forming an almost unbroken area centering around the anterior cord and cell *1st* M_2; stigma small, darker brown, confluent with the major dark area at cord; wing-margin very broadly darkened, most widely so in the anal field where these cells are almost

uniformly clouded; cells *C* and *Sc* uniformly paler brown; veins brown. Venation: Crossvein ***r-m*** present or obliterated by fusion of veins R_{4+5} and M_{1+2}; a supernumerary crossvein in cell ***M***, as in the subgenus.

Abdomen of male obscure yellow, the tergites with conspicuous brown lateral borders; sternites yellow, feebly darkened at the incisures; hypopygium large, somewhat darker, yellowish brown. In female, tergites brown, sternites yellow, the caudal borders of the segments narrowly dark brown. Ovipositor with long slender cerci. Male hypopygium with the lobes of tergite obtusely rounded. Outer dististyle broad at base, narrowed to a tapering apical lobe. Inner dististyle with a basal flange bearing a series of more than twenty short blackened spines arranged in a more or less evident double row; apex of style produced into a slender rostrum that is shallowly emarginate at apex; inner basal portion of style produced into a broad quadrate lobe.

Holotype, ♂, Abitagua, altitude 1,100 meters, April 4, 1940 (MacIntyre). Allotopotype, ♀, Abitagua, Cunibunda, altitude 1,100 meters, April 2, 1940.

The nearest relative is *Tanypremna* (*Pehlkea*) *pallitarsis* Alexander, which differs conspicuously in the restricted dark wing pattern and the very distinct structure of the male hypopygium.

Tanypremna (Tanypremnella) megacera sp. n.

General coloration orange; antennae 10-segmented, elongate in male, the organ being approximately two-thirds the length of the body; flagellar segments with very long erect pubescence; halteres black, the base of stem yellow; legs black the femoral bases restrictedly brightened; wings whitish hyaline, stigma dark brown, conspicuous; abdominal tergites obscure orange, the posterior margins of the segments darkened; eighth segment uniformly blackened.

Male.—Length about 11–13 mm.; wing, 12–13.2 mm.; antenna, about 8–9 mm.

Female.—Length, about 9 mm.; wing, 11 mm.; antenna, about 1.5 mm.

Frontal prolongation of head yellow, relatively short; nasus distinct, black; palpi black. Antennae 10-segmented; in male elongate, approximately two-thirds the length of body; scape and pedicel brown, flagellum black; flagellar segments long-cylindrical, with long conspicuous erect black setae; antennae of female short, with fewer conspicuous verticils and no erect pubescence. Head orange; vertical tubercle low.

Mesonotum almost uniformly orange, the praescutal stripes and centers of scutal lobes vaguely more yellow, poorly delimited; vestiture of mesonotum very sparse and tiny. Pleura orange-yellow, unmarked. Halteres black, the base of stem yellow. Legs with the coxae and trochanters orange-yellow; femora black, the bases restrictedly obscure yellow; tibiae black; tarsi brownish black. Wings whitish hyaline; stigma oval, dark brown, conspicuous; veins dark brown to brownish black. Venation: ***Rs*** gently arcuated,

about two-thirds R_{2+3}; free tip of Sc_2 and R_2 in transverse alignment, with no trace of R_{1+2}; petiole of cell M_1 varying from a little less than one-third to nearly one-half the cell; cell *2nd A* relatively wide.

Abdomen moderately elongate; tergites obscure orange, the posterior margins of the segments broadly dark brown, on the intermediate segments involving about the outer two-fifths; eighth segment and adjoining portions of segments seven and nine forming a narrow black ring; sternites yellow, the eighth sternite blackened. Male hypopygium with the caudal margin of the large tergite transverse. Inner dististyle large and compressed, with dense abundant dark setae; no flange on outer margin as in *microcera*.

Holotype, ♂, Abitagua, altitude 1,800 meters, April 15, 1940 (MacIntyre). Allotopotype, ♀, April 16, 1940. Paratopotypes, 5 ♂♂, April 15–16, 1940.

The only other species of the subgenus with which the present fly might be confused is *Tanypremna* (*Tanypremnella*) *microcera* sp. n., which is well-distinguished by the short antennae in the male and by the structure of the inner dististyle of the male hypopygium.

Tanypremna (Tanypremnella) microcera sp. n.

General coloration of thorax yellowish brown, the pleura uniformly yellow; antennae (male) very short, the flagellar segments without erect setae; femora and tibiae black, not variegated with white; wings whitish subhyaline, cell *Sc* and the stigma dark brown; *Rs* about three-fifths R_{2+3}; cell *2nd A* relatively narrow; abdominal tergites black, the basal rings extensively obscure yellow; a subterminal black ring; male hypopygium yellow, the inner dististyle bearing a conspicuous flange or lobe on outer margin near base.

Male.—Length, about 11 mm.; wing, 12 mm.; antenna, not exceeding 1.5 mm.

Frontal prolongation of head light yellow; mouthparts and palpi black. Antennae with scape and pedicel brown, flagellum black; antennae short, in the unique type broken beyond the fifth segment; first flagellar segment about equal in length to the combined scape and pedicel; second segment about two-thirds the first; third segment shorter than the second; from these proportions it is evident that the remaining segments of the organ would not be longer than the above measurements and the structure is unusually short for a member of this subgenus; flagellar segments generally cylindrical, with delicate and inconspicuous vestiture. Head orange; anterior vertex wide.

Thorax uniformly yellowish brown or light castaneous, the praescutal stripes barely differentiated from the ground, the four stripes narrowly bordered by a slightly darker brown margin; posterior sclerites of notum more infuscated. Pleura yellow, unmarked. Halteres elongate, black, the extreme base of stem yellow. Legs with the coxae and trochanters yellow; remainder of legs black, the terminal tarsal segments broken; no white on either femora or tibiae.

Wings whitish subhyaline; cell *Sc* and the stigma dark brown; veins black. Venation: *Rs* about three-fifths R_{2+3}; R_2 erect, close to extreme tip of R_1; cell *1st* M_2 large, its inner end pointed; cell M_1 longer than its petiole; cell *2nd A* relatively narrow.

Abdominal tergites black, the basal rings extensively obscure yellow, the subterminal segments uniformly blackened; basal sternites more uniformly yellow; hypopygium yellow. Male hypopygium with the inner dististyle bearing a conspicuous flange or lobe on outer margin near base; face of style with about a dozen blackened spines.

Holotype, ♂, Abitagua, altitude 1,800 meters, April 16, 1940 (MacIntyre).

Tanypremna (*Tanypremnella*) *microcera* agrees with *T.* (*T.*) *megacera* sp. n. in the lack of white rings on the femora and tibiae and in the unvariegated thoracic pleura. It differs conspicuously from the other members of the subgenus in the unusually short antennae of the male sex, in this regard more nearly approaching the condition in the typical subgenus *Tanypremna* Osten Sacken.

Limonia Meigen

Limonia (**Limonia**) **subreticulata** sp. n.

Allied to *reticulata;* mesonotal praescutum buffy with a complex dark brown pattern; knobs of halteres brownish black; femora obscure yellow with two very narrow dark brown rings at and just before the tip; extreme base of tibia whitened, followed by a similarly narrow black ring; wings cream-yellow with a heavy reticulated brown pattern; *Sc* long, Sc_1 extending to about opposite three-fourths the length of *Rs;* male hypopygium with the two rostral spines arising from the summit of a common elongate tubercle.

Male.—Length, about 6 mm.; wing, 7 mm.

Rostrum dark brown; palpi black. Antennae with the scape black, pedicel brown; first flagellar segment brownish yellow, succeeding segments black, the outer segments broken; basal flagellar segments oval. Head dark.

Mesonotal praescutum reddish or buffy brown with a sparse pruinosity, irregularly and handsomely patterned and variegated with dark brown or brownish black spots and marblings, including an interrupted series of about four median areas, the last of which is widely expanded laterad to the sides of the sclerite at the suture, leaving small areas of the pale ground behind it; scutum whitened medially, the color continued onto the scutellum; scutal lobes and lateral portions of scutellum brownish black; posterior border of scutellum extensively pale, parascutella dark; postnotum and pleurotergite dark. Pleura variegated buffy brown and black, the latter including a more or less distinct longitudinal stripe across the dorsal sclerites. Halteres with stem yellow, knob brownish black. Legs with the coxae brown, pruinose; trochanters yellow; femora obscure yellow, the extreme tip and a nearly equal subterminal ring dark brown, the two enclosing a pale ring of similar narrowness; tibiae

with extreme base whitened, immediately followed by a blackened ring of equal width; remainder of tibiae brownish yellow; tarsi broken. Wings with the ground-color cream yellow, the prearcular and costal fields deep yellow; entire wing very heavily variegated with a reticulate dark brown pattern, including all the cells except the unpatterned yellow cell *Sc;* major dark areas at one-third the length of cell *R*, at origin of *Rs*, stigma and anterior cord, and at midlength of outer radial field; cells *M* and *Cu* with the ground more or less washed with dusky; cell *C* with about fifteen dark rays; veins brown, yellow in the ground portions of the costal border. Venation: *Sc* long, Sc_1 extending to opposite three-fourths or four-fifths *Rs*, Sc_2 at its tip; *Rs* angulated and spurred at origin; R_{2+3} about one-half longer than R_2; cell *1st* M_2 long, irregular in outline; basal section of M_3 long and arcuated, subequal to distal section and more than twice *m; m-cu* close to fork of *M;* cell *2nd A* wide.

Abdominal tergites dark brown, the sternites paler; hypopygium chiefly darkened. Male hypopygium with the tergite transverse, the caudal margin convexly rounded, the central portion truncate or virtually so; setae of caudal border long but sparse. Basistyle with ventro-mesal lobe simple. Dorsal dististyle a strongly curved black hook, its apex a long straight spine. Ventral dististyle large and fleshy, its area much greater than that of the basistyle; rostral prolongation near apex bearing a very strong common tubercle, with both rostral spines at and immediately before its apex, the lobe subequal in length to either spine. Gonapophyses with mesal-apical lobes straight, flattened, the apex acute and slightly curved.

Holotype, ♂, Abitagua, altitude 1,100 meters, July 2, 1940 (MacIntyre).

Limonia (*Limonia*) *subreticulata* is most similar to *L.* (*L.*) *reticulata* (Alexander) of Mexico and the Greater Antilles, differing conspicuously in the large size, coloration of the body and legs, long *Sc* and other venational details, and, especially, the structure of the male hypopygium. *L.* (*L.*) *pampoecila* Alexander, with a vast range in Tropical America, is more distantly related.

Limonia (Dicranomyia) perdistalis sp. n.

General coloration of mesonotum dark brown, the very broad cephalic and lateral borders of the praescutum yellow; halteres pale yellow; wings with a creamy ground, variegated with dark brown spots; Sc_1 ending almost opposite origin of *Rs*, Sc_2 very far from its tip, at near midlength of the vein; cell *1st* M_2 long, vein M_4 beyond it only about one-fourth to one-fifth its length; male hypopygium with the two spines placed close together at near midlength of the compressed rostral prolongation of the ventral dististyle.

Male.—Length, about 6 mm.; wing, 6.5 mm.

Rostrum and palpi black. Antennae with scape obscure yellow; pedicel brown; basal two flagellar segments obscure yellow, the outer segments passing into dark brown; flagellar segments long-oval to truncated fusiform; terminal segment about one-third longer than the penultimate; verticils relatively short and inconspicuous. Head

obscure yellow, more buffy in central portion, the posterior parts slightly infuscated; anterior vertex relatively wide, about twice the diameter of scape.

Pronotum pale, with a greenish tinge. Mesonotal praescutum with the entire anterior and lateral portions broadly yellow, the restricted disk uniformly and abruptly dark brown, occupying only about one-half the length of the sclerite; scutum similarly dark brown, including the median area, the lateral portions of the lobes abruptly pale; scutellum dark brown, the parascutella obscure yellow; mediotergite dark brown medially, paling to obscure yellow on sides. Praescutum unusually high and convex. Pleura chiefly obscure yellow, the mesepisternum weakly infuscated on central portion. Halteres pale yellow. Legs with the coxae yellow, tinted with green, the fore pair weakly darkened at base; fore trochanters infuscated, the remaining trochanters yellow; remainder of legs broken. Wings with a creamy ground, the prearcular and costal portions clearer yellow; wing-tip in outer radial field narrowly and inconspicuously infumated; conspicuous dark brown areas at arculus, Sc_2, a common area at origin of *Rs* and tip of Sc_1, and the short oval stigma; narrow but very conspicuous seams along cord and outer end of cell *1st* M_2; small dark marginal spots at ends of all longitudinal veins, largest on *2nd A*, the one at tip of M_4 continued basad and becoming confluent with the seam at outer end of cell *1st* M_2; veins yellow, darkened in the infuscated portions. Venation: Sc_1 ending just beyond origin of *Rs*, Sc_2 very far from its tip at near midlength of the vein, Sc_1 thus being longer than *Rs*; R_{4+5} arcuated; cell *1st* M_2 long, the veins beyond it unusually short, even M_{1+2} being only about two-thirds the cell while M_4 is only from one-fourth to one-fifth as long as the cell and shorter than *m*; *m-cu* close to fork of *M*, about one-half longer than the distal section of Cu_1; cell *2nd A* relatively wide, the vein sinuous, strongly curved into the margin.

Abdomen obscure greenish yellow, the caudal borders of tergites five to seven narrowly infuscated; segment eight pale; hypopygium obscure brownish yellow, the basistyle darker. Male hypopygium with the tergite transverse, the caudal border gently convex laterally. Basistyle small, only a little more extensive than its simple ventromesal lobe and scarcely a fifth as large as the fleshy ventral dististyle. Dorsal dististyle a small curved yellow rod, the tip acute. Ventral dististyle with the rostral prolongation compressed-flattened, yellow, with the two spines placed close together at near midlength of the outer margin; spines slightly unequal in length, slightly flattened, blade-like. Gonapophyses with the mesal-apical lobes very short, the acute tips bent laterad. Aedeagus relatively narrow.

Holotype, ♂, Abitagua, altitude 1,100 meters, June 27, 1940 (MacIntyre).

Limonia (*Dicranomyia*) *perdistalis* is so different from all other regional species of the subgenus that it requires no comparison with any. The conspicuous pattern of the mesonotum is somewhat as in various species of the subgenus *Rhipidia*, but the fly is a true *Dicranomyia*. The venational features of unusually long Sc_1 and the very

short veins beyond cell *1st* M_2 furnish very strong characters for the recognition of the fly.

Limonia (Neolimnobia) pugilis sp. n.

General coloration of mesonotum black, including a praescutal discal area, the scutal lobes and the mediotergite; antennae black throughout; ventral portion of vertex velvety black; knobs of halteres blackened; legs black, the femora with the narrow tip and a subterminal ring yellow; wings yellow with a reticulated crossbanded pale brown pattern, the bands interrupted by spots of the ground color; supernumerary crossvein in cell R_3 beyond midlength of cell; cell *1st* M_2 subequal in length to vein M_{1+2} beyond it; abdominal tergites dark brown or brownish black, including the hypopygium; sternites obscure brownish yellow; outermost rostral spine of male hypopygium placed at extreme apex of prolongation.

Male.—Length, about 7 mm.; wing, 9 mm.

Rostrum and palpi black. Antennae black throughout; flagellar segments oval, the incisures well-indicated. Head with disk velvety black, more grayish on front and anterior vertex, along with inner orbits and on the occipital region; anterior vertex narrow, a little less than the diameter of scape.

Pronotum black, gray pruinose. Mesonotal praescutum with three confluent black stripes, the humeral region slightly paler and more pruinose; scutal lobes entirely black, the median region, scutellum and extreme cephalic portion of mediotergite pale; remainder of mediotergite and the parascutella blackened. Pleura and pleurotergite pale, variegated with blackened areas on anepisternum and ventral sternopleurite. Halteres with stem obscure yellow, knob blackened. Legs with fore coxae black, paler at tips; middle and hind coxae yellow; trochanters yellow; femora black, restrictedly brightened basally, the extreme tip and a slightly more extensive subterminal ring yellow, the black ring thus enclosed much wider; tibiae and tarsi black. Wings yellow, with a reticulated, crossbanded, pale brown pattern, appearing roughly as four bands that are interrupted by spots of the ground; basal dark band much broken; second band subequal in width to first, ending at origin of *Rs*, more nearly uninterrupted by pale areas; third band at cord, fourth at level of the supernumerary crossvein in cell R_3 and crossvein *m;* extreme wing-tip further darkened; stigma not darker than the remainder of the patterned areas; veins brown, not brightened in the ground areas. Venation: Sc_1 ending opposite origin of *Rs;* supernumerary crossvein in cell R_3 beyond midlength of cell; cell *1st* M_2 subequal in length to vein M_{1+2} beyond it; *m-cu* at fork of *M*.

Basal abdominal tergite obscure yellow, the posterior border darkened; remaining tergites dark brown or brownish black; sternites obscure brownish yellow; hypopygium uniformly dark brown. Male hypopygium with the tergite deeply emarginate on caudal border. Ventro-mesal lobe of basistyle relatively long. Ventral dististyle large and fleshy, the rostral prolongation unusually short; rostral spines short, the outer one placed at extreme tip of prolongation, the inner more proximad.

Holotype, ♂, Abitagua, Mayorga Playa, altitude 1,100 meters, April 12, 1940 (MacIntyre).

Limonia (*Neolimnobia*) *pugilis* is quite different from *L.* (*N.*) *diva* (Schiner) which appears to be its closest ally. It differs especially in the coloration of the body, antennae, legs and wings, and in slight details of the male hypopygium.

Limonia (Geranomyia) assueta sp. n.

General coloration of thoracic notum dark plumbeous, the praescutum unpatterned; ventral pleurites yellow; halteres and legs uniformly dark; wings with the ground color weakly infuscated, heavily and distinctly patterned with brown; *Sc* long, Sc_1 ending about opposite three-fourths the length of *Rs;* male hypopygium with the rostral spines two, arising separately from very low tubercles placed near the base of the straight rostral prolongation; mesal-apical lobes of gonapophyses appearing as stout blackened horns.

Male.—Length, excluding rostrum, about 5 mm.; wing, 6 mm.; rostrum, about 2.3 mm.

Rostrum relatively long, black throughout, nearly one-half the length of body. Antennae black throughout, relatively short; flagellar segments oval, with short verticils; terminal segment a trifle longer than the penultimate. Head dark with indications of a narrow pale median line; eyes large; anterior vertex narrow.

Pronotum dark brown. Mesonotal praescutum uniformly dark plumbeous or grayish brown, without stripes; posterior sclerites of notum similar in color, the median region of scutum paler; notum glabrous. Pleura with ventral portions, including sternopleurite, meral region and all coxae yellow, the dorsal sclerites and pleurotergite infuscated, forming a more or less distinct dorsal stripe. Halteres infuscated. Legs with coxae yellow, as described; trochanters yellow; remainder of legs black, the femoral bases not or scarcely brightened. Wings with a weak brown tinge, heavily patterned with darker brown, the areas unusually clear and well-defined, distributed as follows: Supernumerary crossvein in cell *Sc;* origin of *Rs;* fork of *Sc;* stigma; cord and outer end of cell *1st* M_2; distal ends of all longitudinal veins, largest at R_3 and *2nd A*, those at wing-tip small and confluent; veins dark. Venation: *Sc* long, Sc_1 ending about opposite three-fourths the length of *Rs*, Sc_2 a short distance from its tip; a supernumerary crossvein in cell *Sc;* cell *1st* M_2 a little shorter than vein M_{1+2} beyond it; *m-cu* close to fork of *M*.

Abdominal tergites brownish black; basal sternites obscure yellow; hypopygium black, the ventral dististyle pale. Male hypopygium with the tergite transverse, the lateral lobes low, obtusely rounded, provided with long coarse setae. Basistyle of moderate size, the ventro-mesal lobe simple. Dorsal dististyle a gently curved sclerotized blade, the tip acute. Ventral dististyle of moderate size, its area about one-half greater than that of the basistyle; rostral prolongation straight, slender, the tip narrowly obtuse; rostral spines two, placed close together near base of prolongation, arising from very low basal tubercles. Gonapophyses with mesal-apical lobes appearing as blackened stout horns, gently curved to the acute tips.

Holotype, ♂, Abitagua, Mayorga Playa, altitude 1,100 meters, April 12, 1940 (MacIntyre).

In its wing-pattern, *Limonia* (*Geranomyia*) *assueta* is most like *L.* (*G.*) *biargentata* Alexander and *L.* (*G.*) *separata* Alexander, but from the nature of its thoracic coloration belongs to an entirely different section of the subgenus. It is well-distinguished by the unvariegated praescutum, uniformly darkened halteres and legs, the very clearly defined wing spots, and the structure of the male hypopygium.

Limonia (**Geranomyia**) **nugatoria** sp. n.

General coloration of mesonotum dark brown or brownish black, with indications of three still darker stripes on cephalic third of praescutum; dorsal pleurites darkened; wings almost uniformly and strongly infuscated, the small oval stigma darker brown; *Sc* long, Sc_1 ending beyond midlength of *Rs;* male hypopygium with the ventral dististyle large and fleshy, its area about three times the basistyle; rostral prolongation pendant, pale, with two long straight black spines arising close together from small separate tubercles; mesal-apical lobes of gonapophyses appearing as short curved horns.

Male.—Length, excluding rostrum, about 5 mm.; wing, 6 mm.; rostrum, about 3 mm.

Rostrum of moderate length, a little exceeding one-half the length of remainder of body, black, the tips of the labial palpi a trifle paler. Antennae black; flagellar segments oval, verticils short. Head black, with a gray dorso-median stripe.

Pronotum brown. Mesonotal praescutum dark brown, with indications of three still darker, brownish black stripes on the cephalic third, these becoming obsolete behind; posterior sclerites of notum dark brown to brownish black, the median area of scutum narrowly pale. Pleura with dorsal sclerites, including the pleurotergite, brownish black, the ventral pleurites more reddish brown, this including the sternopleurite and meral region. Halteres uniformly blackened. Legs with coxae reddish brown; trochanters obscure yellow; remainder of legs broken. Wings with an almost uniform strong brownish tinge, only the prearcular field a little paler; stigma small, oval, darker brown; veins dark brown. Venation: *Sc* long, Sc_1 ending just beyond midlength of *Rs*, Sc_2 at its tip; a supernumerary crossvein at near midlength of cell *Sc;* cell *1st* M_2 subequal in length to vein M_{1+2} beyond it; *m-cu* a short distance beyond fork of *M;* vein *2nd A* strongly sinuous.

Abdominal tergites and hypopygium brownish black; basal sternites obscure yellow, passing into brownish yellow. Male hypopygium with the tergite transverse, moderately long, the caudal margin weakly emarginate. Basistyle with ventro-mesal lobe simple. Dorsal dististyle a blackened curved hook, very gradually narrowed to a long acute spinous point. Ventral dististyle elongate, its area exceeding three times that of the basistyle; rostral prolongation small, pendant, pale, the apex obliquely truncated, the ventral angle obtuse; rostral spines two, subequal, black, arising from small separate basal tubercles at base of prolongation. Gonapophyses with mesal-

apical lobes entirely blackened, appearing as short curved horns, their tips acute.

Holotype, ♂, Abitagua, Mayorga Playa, altitude 1,100 meters, April 12, 1940 (MacIntyre).

Other small regional species of the subgenus with almost uniformly infumated wings include *Limonia* (*Geranomyia*) *conquisita* Alexander, *L.* (*G.*) *disparilis* Alexander, *L.* (*G.*) *fluxa* Alexander and *L.* (*G.*) *microphaea* Alexander. The present fly differs from all of these in the long *Sc* and in the structure of the male hypopygium.

Limonia (Geranomyia) subpentheres sp. n.

General coloration brownish black, the praescutum with three blackish stripes in addition to the darkened lateral borders; rostrum relatively short; wings with a weak brownish tinge, the base more whitened; *Sc* short, Sc_2 lacking; male hypopygium with a single very long rostral spine and a subtending, much more slender seta or setoid spine, both arising from the apex of an unusually long tubercle; prolongation extended beyond the level of origin of the tubercle.

Male.—Length, excluding rostrum, about 5 mm.; wing, 5.3 mm.; rostrum, about 2 mm.

Rostrum black, relatively short, being a little less than one-half the length of body. Antennae black throughout, relatively short; basal flagellar segments short-oval, the outer segments more elongate; terminal segment nearly twice the length of the penultimate. Head with the anterior vertex narrow, less than one-half the diameter of scape, the eyes correspondingly large; head black, the anterior vertex and a backward extension from it more grayish.

Pronotum pale medially, dark on sides. Mesonotal praescutum with the ground color grayish, with three conspicuous blackish stripes, the median one very broad, the sublateral pair narrow; in addition to these stripes the lateral margins of the sclerite are broadly blackened; humeral region reddish brown; posterior sclerites of notum chiefly brownish black. Pleura with the dorsal sclerites, including the pleurotergite, blackened, the ventral areas paler brown. Halteres black, the extreme base of stem obscure yellow. Legs with the coxae reddish brown, the fore pair darker; trochanters brownish testaceous; remainder of legs broken. Wings with a weak brownish tinge, the prearcular field more whitened; stigma small, oval, only slightly darker than the ground; veins brown. Venation: *Sc* short, Sc_1 ending about opposite one-fifth the length of *Rs*, Sc_2 lost by atrophy; cell *1st* M_2 moderately long, about equal in length to vein M_4 beyond it; *m-cu* shortly beyond fork of *M*.

Abdominal tergites, including hypopygium, dark brown; basal sternites paler. Male hypopygium with the lateral tergal lobes conspicuous, obtusely rounded, with long conspicuous black setae that continue along the lateral borders to the base of sclerite. Basistyle relatively small; ventro-mesal lobe simple. Dorsal dististyle a small, gently curved rod, the tip acute. Ventral dististyle large and fleshy, its total area about three times that of basistyle; rostral prolongation glabrous, basad of the tubercle stout, beyond this point

abruptly narrowed into a slender lobe that is nearly equal in length to the basal tubercle of the rostral spines; only a single well-developed rostral spine, this very long, slender, curved, its length greater than the dorsal dististyle; spine arising from an unusually long basal tubercle that is about one-half the length of spine; in addition to the major spine there is a strong seta or setoid spine likewise arising from the apex of the tubercle, subequal in length to the major rostral spine but very slender; despite its setoid nature, this might be considered as representing a second rostral spine. Gonapophyses with mesal-apical lobe slender, pale throughout.

Holotype, ♂, Abitagua, Mayorga Playa, altitude 1,100 meters, April 12, 1940 (MacIntyre).

Limonia (*Geranomyia*) *subpentheres* is most similar to the Mexican *L.* (*G.*) *pentheres* Alexander and *L.* (*G.*) *neopentheres* Alexander, differing conspicuously from both in the short *Sc* and in the structure of the male hypopygium.

Limonia (**Geranomyia**) **hirsutinota** sp. n.

General coloration of mesonotum obscure brownish yellow, the praescutum with three conspicuous brown stripes in addition to the darkened lateral borders; praescutum and scutum with abundant, long and conspicuous, erect black setae; femora obscure yellow, the apices broadly yellow, enclosing a narrow brown subterminal ring; wings with cells of basal half infuscated, deepest in the anal cells, the outer cells and costal border pale yellow; stigma and narrow seams along cord and outer end of cell *1st* M_2 darkened; *Sc* long; abdominal tergites dark brown; male hypopygium with the rostral prolongation of ventral dististyle unusually short and stout, bearing two long spines from a low common sclerotized base.

Male.—Length, excluding rostrum, about 6–7 mm.; wing, 6.8–8 mm.; rostrum, about 4.5–4.8 mm.

Rostrum elongate, black, the tips of the labial palpi slightly paler. Antennae black throughout, somewhat longer than usual in the subgenus; flagellar segments cylindrical, a little shorter than their longest verticils, the longest of which are unilaterally arranged; terminal segment about one-third longer than the penultimate. Head with the anterior vertex gray, the posterior vertex more blackened.

Pronotum light brown above, darker on sides. Mesonotal praescutum obscure yellow or brownish yellow, with three conspicuous brown stripes, the median one a little darker in color than the sublaterals, narrowed behind and reaching the suture; lateral margins of praescutum pale brown; scutum buffy, the narrow midline still paler, the scutal lobes with their mesal edges narrowly bordered by darker, being a direct prolongation of the sublateral praescutal stripe; scutellum weakly infuscated, with the central line pale, the parascutella slightly darker; postnotum brown; praescutum and scutum with abundant long and conspicuous erect setae occupying the sublateral dark stripes and the outer pale interspaces. Pleura pale brown on dorsal portions, the ventral areas yellow. Halteres

with stem yellow, knob brownish black. Legs with the coxae and trochanters pale yellow, the fore coxae a trifle darker; femora obscure yellow to brownish yellow, the apex broadly yellow, enclosing a conspicuous brown subterminal ring; tibiae pale brown, the distal end and the tarsi even paler. Wings with about the proximal half weakly infuscated, becoming more intense in the Anal cells, the prearcular and costal fields remaining pale yellow; distal portion of wing pale yellow, the stigma and narrow seams at fork of *Sc*, along cord and outer end of cell *1st* M_2 pale brown; veins brown, *Sc* more yellow. Costal fringe (male) erect and conspicuous on basal third of wing, outwardly becoming more appressed and inconspicuous. Venation: Sc_1 ending about opposite two-thirds the length of *Rs*, Sc_2 near its tip; a supernumerary crossvein in cell *Sc* at near three-fifths the length; *Rs* angulated at origin; cell *1st* M_2 about equal in length to vein M_{1+2} beyond it; *m-cu* at fork of *M;* vein *2nd A* nearly straight.

Abdominal tergites dark brown, sternites obscure yellow; hypopygium dark. Male hypopygium with the tergite transverse, the low lobes provided with abundant conspicuous setae. Basistyle relatively small, the ventro-mesal lobe relatively long and slender but simple. Dorsal dististyle a gently curved rod, the apex abruptly narrowed into a spine. Ventral dististyle large and fleshy, its total area exceeding twice that of the basistyle; rostral prolongation short and stout, the two rostral spines placed at near midlength on outer margin; spines very long, exceeding the prolongation in length, arising from a very low common base but placed one immediately distad of the other so the base is elongate; spines slightly unequal in length; apex of prolongation obliquely truncate, its lower ventral angle a short point. Gonapophyses with mesal-apical lobe blackened, narrowed to the small, slightly decurved, blackened point.

Holotype, ♂, Abitagua, altitude 1,100 meters, March 21, 1940 (MacIntyre). Paratopotype, ♂, April 15, 1940.

From all other members of the subgenus having a somewhat similar praescutal pattern, including a host of species in Tropical America, the present fly differs conspicuously in the pattern of the wings, the conspicuous erect setae on the mesonotum, and the details of structure of the male hypopygium, especially the ventral dististyle and its rostral prolongation. The nature of the thoracic setae is somewhat as in the otherwise very different *Limonia* (*Geranomyia*) *deliciosa* Alexander.

Limonia (Rhipidia) polyclada sp. n.

General coloration of mesonotum dark brown, the lateral borders very broadly and abruptly yellow; antennae with eleven branched segments, flagellar segments two to eleven, inclusive, each with two long branches, the terminal segment with a conspicuous basal branch and an additional small tubercle; thoracic pleura dark brown; legs yellow; wings yellow, with a restricted but conspicuous dark brown pattern; inner ends of cells R_3 and *1st* M_2 lying far proximad of cell R_5; cell *2nd A* wide; abdomen brownish yellow; hypopygium with the rostral

prolongation long, bearing two elongate spines at near two-thirds the length, these spines placed close together on small individual tubercles.

Male.—Length, about 6.5 mm.; wing, 7.6 mm.; antenna, about 2 mm.

Rostrum and palpi reduced, brown. Antennae of moderate length, pale yellow, the basal enlargements of the flagellar segments and the branches pale brown or brownish yellow; scape with ventral face dark brown; first flagellar segment strongly produced but not branched; flagellar segments two to eleven, inclusive, each with two very long branches, those of segment two only a little shorter than the longest branches of the intermediate segments, being nearly three times the length of segment; longest branch slightly exceeding three times the segment; flagellar segment eleven with branches about equal to one and one-half times the segment; terminal segment very long, irregularly branched, the basal branch longest, about one-half the total length of segment; at near midlength of this segment a small lobe or tubercle representing a rudimentary second branch; flagellar segments in addition to the elongate black verticils of the basal enlargements have abundant delicate pale setae on the branches. Head light cinnamon brown.

Pronotum and very broad margins of the praescutum, scutum, scutellum and postnotum abruptly yellow, the remainder of the disk uniformly dark brown; on praescutum, the yellow border includes the cephalic half of the sclerite; on the postnotal mediotergite all but a darkened triangle on cephalic portion; parascutella and pleurotergite yellow. Pleura abruptly dark brown, this including all but the dorsopleural region. Halteres yellow, the knobs very weakly darkened. Legs with the coxae dark brown; trochanters yellow; remainder of legs yellow, the terminal three tarsal segments abruptly blackened. Wings yellow, the costal border more saturated; a restricted but conspicuous dark brown pattern, including spots and seams at origin of *Rs*, fork of *Sc*, stigma, along cord and outer end of cell *1st* M_2 and a major area in cell *1st A* at bend of vein *2nd A*, this latter enclosing a small spur of a veinlet; a marginal series of brown spots on all longitudinal veins from R_3 to *2nd A* inclusive, that on R_3 largest, the others subequal in size to one another, that on *2nd A* entirely disconnected from the larger subterminal darkening above described; veins yellow, dark brown in the infuscated portions. Venation: *Sc* long, Sc_1 ending about opposite two-thirds the length of *Rs*, Sc_2 at its tip; *Rs* strongly arcuated at origin; free tip of Sc_2 and R_2 in transverse alignment; inner ends of cells R_3 and *1st* M_2 lying far proximad of cell R_5; cell *1st* M_2 relatively long, nearly equal in total length to vein M_{1+2} beyond it; *m-cu* at or shortly before fork of *M*, shorter than distal section of Cu_1; cell *2nd A* wide.

Abdomen obscure yellow or brownish yellow; hypopygium uniformly yellow. Male hypopygium with the tergite transverse, the lobes very low. Ventro-mesal lobe of basistyle with a small lateral lobule on its face. Dorsal dististyle a long conspicuous darkened rod, the acute slender tip decurved. Ventral dististyle relatively small, with a long conspicuous rostral prolongation, the two long,

gently curved spines placed close together at near two-thirds the length of the prolongation, arising from small individual tubercles. Gonapophyses with mesal-apical lobes long and straight, darkened, the tips suddenly narrowed.

Holotype, ♂, Abitagua, altitude 1,100 meters, June 27, 1940 (MacIntyre).

Limonia (*Rhipida*) *polyclada* is very distinct from all described species of the subgenus. The branched terminal segment of the antenna is an almost unique character that separates the species from all others in the Neotropical fauna. The peculiar thoracic pattern is somewhat as found in other species of *Rhipidia*, as *L.* (*R.*) *annulicornis* (Enderlein) and *L.* (*R.*) *subpectinata* (Williston), as well as in species of other allied subgenera, including *L.* (*Dicranomyia*) *perdistalis* sp. n. The only other described species of *Rhipidia* having pectinations on the terminal flagellar segment is *L.* (*R.*) *antennata* (Brunetti) of the western Himalayas (*see* Alexander, Philippine Journ. Sci., 56: 549–550; 1935).

Limonia (Rhipidia) sprucei sp. n.

General coloration of notum brown, the lateral praescutal borders broadly yellow; pleura yellow with a conspicuous black longitudinal stripe; antennae (male) with eight flagellar segments that are provided with two long slender branches each; antennae black throughout, including the flagellar pedicels; halteres and legs black; wings with a strong blackish tinge, almost unpatterned; abdominal tergites brownish black, basal sternites yellow with blackened caudal borders; male hypopygium with the ventro-mesal lobe of basistyle bearing a small accessory lobule; rostral prolongation long and slender, with two relatively short spines placed on the face of prolongation just beyond midlength.

Male.—Length, about 5 mm.; wing, 5.5 mm.; antenna, about 2.4 mm.

Rostrum and palpi black. Antennae (male) black throughout, including the apical pedicels of all flagellar segments; first flagellar segment merely produced; flagellar segments two to nine, inclusive, each with two very long branches; segment ten with a single long branch that exceeds the segment in length; segment eleven with the basal enlargement simple; longest branches nearly three times the segments, clothed with abundant delicate setulae. Head dark brown, sparsely pruinose; eyes very large, almost contiguous, reducing the anterior vertex to a linear strip.

Pronotum black. Mesonotal praescutum reddish brown, the lateral margins broadly yellow; posterior sclerites of notum brown, the median area of scutum narrowly paler. Pleura and pleurotergite yellow, with a relatively narrow but very conspicuous longitudinal black stripe extending from the pronotum to the base of abdomen, passing beneath the halteres. Halteres blackened, the extreme base of stem yellow. Legs with the coxae and trochanters yellow; remainder of legs uniformly black. Wings with a strong blackish tinge, almost unvariegated except by the slightly darker oval stigma; cord and outer end of cell *1st* M_2 very narrowly and

vaguely seamed with darker; veins and trichia dark brown. Macrotrichia of veins long and conspicuous. Venation: *Sc* long, Sc_1 ending about opposite three-fourths *Rs*, Sc_2 at its tip; *Rs* weakly angulated at origin; vein R_3 decurved at outer end; cell *1st* M_2 shorter than vein M_4 beyond it; *m-cu* a short distance beyond fork of *M*.

Abdominal tergites, including hypopygium, brownish black; basal sternites yellow, the caudal borders darkened. Male hypopygium with the tergite transverse, narrowed outwardly, the caudal margin very gently emarginate. Basistyle with the ventro-mesal lobe obtuse, with a small secondary lobule on the cephalic face. Dorsal dististyle a gently curved rod, the apex suddenly narrowed into a spine. Ventral dististyle of moderate size, its total area slightly greater than that of basistyle; rostral prolongation long and slender; rostral spines two, placed close together on face of style just beyond midlength, arising from small separate tubercles; spines subequal in length; on opposite face of prolongation from the spines with two very strong spinous setae. Gonapophyses with mesal-apical lobes stout, nearly straight, the tips gently expanded and weakly apiculate.

Holotype, ♂, Abitagua, altitude 1,100 meters, March 22, 1940 (MacIntyre).

It is particularly fitting that a species from Abitagua be dedicated to the great botanist and student of the Bryophytes, Richard Spruce. The fly is readily told from other species with eight long-bipectinate flagellar segments by the coloration of the thorax and legs, and especially by the almost uniformly blackened wings. It is most similar to species such as *Limonia* (*Rhipidia*) *costalis* (Williston) and *L.* (*R.*) *variicosta* Alexander.

Orimarga Osten Sacken

Orimarga (**Orimarga**) **saturnina** sp. n.

Allied to *funerula;* general coloration black, the thoracic pleura with a conspicuous silvery longitudinal stripe; legs black throughout; wings with a strong blackish suffusion; R_{1+2} elongate; cell M_3 longer than its petiole; *m-cu* about opposite midlength of *Rs;* male hypopygium with the dististyles unusually short, especially the nearly straight outer style; setae of mesal face of basistyle simple.

Male.—Length, about 6.5–7 mm.; wing, 5.5–6 mm.

Rostrum and palpi black. Antennae black throughout; flagellar segments oval, with very short glabrous apical pedicels; terminal segment short-oval, only about one-third the penultimate; verticils short. Head light gray or silvery gray in front, darker gray behind.

Pronotum silvery gray pruinose. Mesonotum black, the surface dull to rather strongly polished. Pleura black, with a broad silvery longitudinal stripe extending from behind the fore coxae to above the hind coxae, narrowed posteriorly. Halteres with stem dusky, knob darkened. Legs black throughout. Wings with a strong blackish suffusion, somewhat stronger on anterior half; restricted whitish streaks in posterior prearcular field, distal end of cell R_5 and as narrow borders to vein *M* in cell *R*, and veins M_{1+2}, M_{3+4} and M_4;

veins brown. Costal fringe relatively short but dense. Venation: *Sc* long, Sc_1 ending about opposite one-third to two-fifths the length of *Rs*, Sc_2 at its extreme tip, just before midlength of *Rs;* free tip of Sc_2 distinct; distal section of R_1 a little more than one-half the long R_{1+2}; cell M_3 much longer than its petiole; *m-cu* about opposite midlength of *Rs;* cell *2nd A* relatively wide, especially at base.

Abdomen elongate, black throughout. Male hypopygium with the dististyles unusually short, especially the nearly straight outer style; inner dististyle a trifle longer, weakly dilated outwardly, with short inconspicuous setae only; a small oval lobe with long setae at junction of the two dististyles. Setae on mesal face of basistyle moderately long and conspicuous but simple. Phallosome with the apical lobe of inner pair of apophyses unusually long and narrow, the oblique apex microscopically serrulate or roughened, the degree varying in different specimens; outer apophyses narrowed to acute tips.

Holotype, ♂, Abitagua, altitude 1,100 meters, March 18, 1940 (MacIntyre). Paratopotypes, 13♂♂, on five pins, one also including the holotype specimen.

Orimarga (*Orimarga*) *saturnina* is generally similar to other black-winged members of the subgenus having uniformly blackened tarsi and elongate vein R_{1+2}, including *O.* (*O.*) *funerula* Alexander, *O.* (*O.*) *lanei* Alexander, and *O.* (*O.*) *scabriseta* Alexander. It differs conspicuously in the details of venation and, especially, in the very different structure of the male hypopygium.

Orimarga (Orimarga) chionopus sp. n.

Allied to *niveitarsis;* general coloration polished black, the lateral margin of mesonotum and the ventral pleura each with a narrow silvery longitudinal stripe; legs black, the tarsi abruptly white, including the tips of the basitarsi; wings narrow, the prearcular region petiolate, disk strongly suffused with blackish; costal fringe long in both sexes; *Sc* short, Sc_1 ending some distance before origin of *Rs;* R_{1+2} subequal to or nearly twice as long as R_2; *m-cu* opposite origin of *Rs;* cell *2nd A* narrow; male hypopygium with the dististyle trilobed; phallosome complex.

Male.—Length, about 6.5 mm.; wing, 5.8 mm.

Female.—Length, about 7–9 mm.; wing, 5.2–6 mm.

Rostrum and palpi black. Antennae black, the scape more pruinose; antennae 15-segmented; flagellar segments oval, constricted at the incisures, with very short glabrous apical pedicels; terminal segment one-half longer than the penultimate; verticils exceeding the segments in length. Head black, sparsely pruinose, the front more silvery.

Thorax polished black, with two narrow silvery longitudinal stripes, the more dorsal including the lateral border of the praescutum and scutum; second stripe on pleura, occupying the dorsal sternopleurite, behind traversing the meron. Halteres elongate, black. Legs with the coxae brownish black; trochanters testaceous yellow, the fore pair brown; femora brownish black, the bases restrictedly pale; tibiae black; basitarsi black, the distal third whitened; suc-

ceeding segments white, the outer two again darkened. Wings narrow, strongly petiolate at base; disk strongly suffused with blackish, somewhat more saturated in the costal portion and along vein *Cu;* prearcular field more whitened; veins of outer medial field narrowly bordered by pale; veins dark brown. Costal fringe long and conspicuous in both sexes. Venation: *Sc* short, Sc_1 ending a distance before origin of *Rs* about equal to vein R_{1+2}; *Rs* long, angulated at origin; R_{1+2} a little shorter than R_{2+3}, subequal to or nearly twice R_2 alone; *r-m* a little proximad of level of R_2; petiole of cell M_3 about equal to or slightly shorter than the cell; *m-cu* opposite origin of *Rs;* cell *2nd A* relatively short and narrow; vein *2nd A* pale, gently arcuated, without trichia.

Abdomen, including hypopygium, black. Male hypopygium with the dististyle trilobed, the outer arm a slender glabrous rod, the inner arm nearly as long, bearing a few very long setae at its apex and another single seta on face near base; intermediate arm broad-based, the distal third narrowed into a slender spinous point; surface of style basad of lobes with several long scattered setae. Basistyle with normal strong setae. Phallosome complex; aedeagus elongate, deeply bifid at tip; gonapophyses produced into two spinous points, the outermost longer and stronger, and a pale capitate structure covered with numerous pale setae.

Holotype, ♂, Abitagua, altitude 1,100 meters, March 21, 1940 (MacIntyre). Allotopotype, ♀. Paratopotype, ♀, Cunibunda, Abitagua, March 22, 1940.

The nearest relative of the present fly is *Orimarga* (*Orimarga*) *niveitarsis* Alexander, and its more northern race, *majuscula* Alexander, of Middle America. Both species have the tarsi abruptly snowy white and vein *Sc* unusually short. The present fly is well-distinguished by the blackened wings and by the details of venation. Unfortunately the male hypopygium of *niveitarsis* has not been described but will unquestionably provide further specific characters when made known.

Limnophila Macquart

Limnophila pergracilis sp. n.

General coloration dark brown, the thorax without distinct stripes; antennae (male) very long, almost equalling the body in length, the flagellar segments with conspicuous outspreading verticils; legs dark brown; wings whitish, heavily patterned with brown; *Sc* long; R_2 and R_{1+2} subequal; cell M_1 shorter than its petiole; abdominal tergites brownish black, sternites weakly bicolored, yellow, the bases broadly brownish black; male hypopygium with the apex of outer dististyle terminating in a simple spine; inner dististyle with a setiferous tubercle on outer margin shortly before apex.

Male.—Length, about 6.5–7 mm.; wing, 6.5–7 mm.; antenna, about 6.3–6.5 mm.

Rostrum short, black; palpi black. Antennae (male) very long and slender, almost as long as the entire body; scape black, pedicel and flagellum lighter colored, the extreme bases of the flagellar

segments a trifle paler; flagellar segments elongate-cylindrical, with long, conspicuous, outspreading verticils. Head dark brown; anterior vertex narrow, a little less than the diameter of scape; eyes large; vertex with coarse black setae.

Pronotum dark brown. Mesonotum almost uniform dark brown, without distinct stripes, the surface glabrous. Pleura dark brown, the sternopleurite a little brightened. Halteres relatively long and slender, infuscated, the base of stem paler. Legs with coxae and trochanters brownish testaceous; remainder of legs dark brown; tibial spurs present; claws simple. Wings with the ground color whitish, heavily patterned with brown, the dark color in the type specimen subequal in total amount to the ground, in the paratype the dark markings somewhat more restricted, being smaller than the ground interspaces; dark areas including major markings before arculus; beyond arculus, extending from *C* to *M;* a conspicuous area at origin of *Rs*, extending to *C;* extensive seams across cord and outer end of cell *1st* M_2*;* cells beyond cord heavily variegated by dark spots; major clouds at ends of veins *1st A* and *2nd A;* axilla narrowly darkened; cells *C* and *Sc* slightly more yellowish in the ground areas; veins yellow, darker in the clouded portions. Venation: Anterior arculus present; *Sc* long, Sc_1 ending beyond fork of R_{2+3+4}, Sc_2 at its tip; *Rs* long, in alignment with R_{2+3+4}*;* R_2 and R_{1+2} subequal; cell M_1 shorter than its petiole; cell *1st* M_2 elongate, rectangular; *m-cu* about two-thirds its length beyond fork of *M;* cell *2nd A* wide.

Abdominal tergites brownish black, the sternites weakly bicolored, obscure yellow, with the basal third brownish black; hypopygium brownish black. Male hypopygium with the outer dististyle a straight blackened rod, the outer apical angle terminating in a single acute spine, the usual second spine or point atrophied or virtually so. Inner dististyle narrowed at apex, with a small setiferous tubercle on outer margin shortly before apex. Gonapophyses with the spinous points very unequal, the inner one very small.

Holotype, ♂, Abitagua, Cunibunda, altitude 1,100 meters, April 8, 1940 (MacIntyre). Paratopotype, ♂, Abitagua, June 27, 1940.

Limnophila pergracilis is closest to *L. nematocera* Alexander, likewise from Abitagua. It differs conspicuously in the coloration, in the great reduction of dark color in the wing pattern, and in the structure of the male hypopygium, especially of the outer dististyle. I had formerly placed *nematocera* in the genus *Austrolimnophila* since the anterior arculus in the type specimen is very faint to obsolete, much less indicated than in the present fly. Both flies are obviously congeneric and until more information concerning them becomes available it appears best to place them in *Limnophila*.

Elephantomyia Osten Sacken

Elephantomyia primitiva sp. n.

General coloration brownish black; rostrum, halteres and legs brownish black; eyes of male large, the anterior vertex much reduced; wings brownish yellow, heavily patterned with darker brown, including

a broad subbasal band; cell *1st* M_2 small; male hypopygium with the aedeagus simple, broad at base, the short apex slender, straight.

Male.—Length, excluding rostrum, about 5.5–6.5 mm.; wing, 6.5–7.5 mm.

Rostrum black, relatively long, the apex apparently broken in the specimens available, in the longest of these the beak about equal in length to the head and most of thorax combined. Antennae 15-segmented; dark throughout; flagellar segments cylindrical, decreasing in size outwardly, the terminal segment pointed at apex; verticils of outer segments about twice as long as the basal ones but still not very conspicuous. Eyes large, the anterior vertex at narrowest point greatly reduced, only about one-fourth to one-fifth the diameter of scape; head brown, the anterior vertex gray.

Pronotum dark brown. Mesonotum brown, the median region of praescutum even darker, brownish black; posterior sclerites blackened, the parascutella a little paler. Pleura brownish black. Halteres brownish black, the base of stem paler. Legs brownish black, the femoral bases a trifle brightened; setae of legs simple (thus excluding *Toxorhina-Ceratocheilus*). Wings with the restricted ground brownish yellow, heavily patterned with darker brown, as follows: A major wash across the basal cells beyond arculus, involving about one-half the length of cells *R*, *M* and *Cu*, the basal two-thirds of *1st A* and all of *2nd A*, the prearcular field paler; a broad brown band at cord, extending from stigma back to vein *Cu*, in cases so wide along the cord as to completely fill cell *1st* M_2; conspicuous seams along the whole length of *Rs*, all of vein *Cu*, cell *C* and the outer radial margin to the wing-apex; cell *Sc* slightly more yellowish brown, a little paler than cell *C* but darker than the ground; veins brown, veins *C*, *Sc*, R and the prearcular field more yellowish brown. Venation: *Sc* long, Sc_1 ending just before fork of *Rs*, Sc_2 at its tip; *Rs* very strongly arcuated at origin, in longitudinal alignment with R_5; R_{2+3+4} perpendicular at origin; both branches of *Rs* long and extending generally parallel to one another for their entire length, cell R_2 at margin thus very extensive; cell *1st* M_2 short, subquadrate in outline, much shorter than any of the veins beyond it; *m-cu* at or very close to fork of *M*.

Abdominal tergites brownish black, the sternites paler, yellowish brown. Male hypopygium with the basistyle simple. Outer dististyle small, straight, the apex weakly and obtusely bilobed. Inner dististyle longer than the outer, its apex a compressed cultriform blade. What appear to represent gonapophyses are flattened blades directed mesad. Aedeagus simple, broad at base, the short apex slender and straight.

Holotype, ♂, Abitagua, altitude 1,100 meters, March 21, 1940 (MacIntyre). Paratopotype, ♂, with the type.

I am assigning this very distinct and interesting fly to *Elephantomyia* with the realization that it deviates from the characters of the genotype in certain respects, notably the venation and the structure of the male hypopygium, such as the simple aedeagus. The possibility is not excluded that further collections and more material in this immediate

group will require a new subgeneric group for the fly. The species is readily told from all other regional species of the genus by the conspicuously patterned wings, the only other species showing this character being *Elephantomyia* (*Elephantomyina*) *supernumeraria* Alexander, belonging to a distinct subgenus and readily told by the presence of a supernumerary crossvein in cell R_3 of the wings.

Teucholabis Osten Sacken

Teucholabis (Teucholabis) spica sp. n.

Belongs to the *melanocephala* group; general coloration of mesonotum polished yellow, the praescutum with three more reddish stripes, the cephalic portions of the lateral stripes blackened; scutellum and mediotergite yellow; pleura chiefly dark; femora yellow, with two narrow brown rings, both before the tip; a modified area on proximal end of posterior basitarsus in male; wings light yellow, with three pale brown crossbands, the last one narrow and apical; cell *1st* M_2 closed; male hypopygium with the spine of basistyle terminating in two slender blackened points.

Male.—Length, about 10 mm.; wing, 8.3 mm.

Rostrum black above, paler beneath; palpi black. Antennae with scape brown, pedicel and flagellum black; flagellar segments cylindrical; longest verticils unilaterally distributed, about twice the length of the segments. Head with the front pale, the vertex polished black, paling to reddish behind.

Cervical region black. Pronotum obscure yellow. Mesonotal praescutum polished yellow, with three more reddish stripes, the cephalic portions of the lateral stripes blackened; scutum yellow, the lobes with polished black areas; scutellum and mediotergite yellow, the pleurotergite extensively dark brown, its posterior border yellow. Pleura dark liver brown, the dorsal sternopleurite with an extensive area of appressed silvery setulae; posterior border of pteropleurite with a group of long yellow setae. Halteres with stem yellow, knob weakly darkened. Legs with the coxae yellow, the fore and middle pair weakly infuscated; trochanters yellow; femora yellow, each with two narrow and poorly indicated brown rings, the outer narrow, less than its own length before the tip, the second dark ring at or before midlength, broader and more diffuse on posterior legs; tibiae and tarsi yellow, the terminal tarsal segments dark brown; posterior basitarsi weakly dilated and provided with a modified area at proximal end. Wings light yellow, with three pale brown crossbands, the most basal extending from cell *R* into cell *2nd A;* second band broad, lying at, but chiefly beyond, the cord, completely filling cell *1st* M_2; apical band small and restricted, including only the wing-tip from cell R_2 to *2nd* M_2, inclusive; stigma oval, darker brown, included in the second dark band; veins light yellow, brown in the darkened areas. Costal fringe short but dense. Venation: Sc_1 ending about opposite midlength of the arcuated *Rs*, Sc_2 at near one-sixth the length; R_2 oblique, longer than R_{1+2}, the latter strongly upcurved to the

margin; cell *1st* M_2 nearly as long as vein M_3 beyond it; *m-cu* about one-third its length beyond fork of *M;* cell *2nd A* wide.

Abdomen yellow, darkened laterally, leaving the median region paler; hypopygium weakly infuscated. Sternal pocket very conspicuous, as in the *melanocephala* group. Male hypopygium with the spine of basistyle a strong erect rod that is split at apex into two black spines, one a direct prolongation of the axis, the other slightly longer, directed at a right angle and mesad; flange of basistyle long and conspicuous, its margin with microscopic black teeth. Outer dististyle a gently sinuous simple rod that is more than one-half longer than the rod of basistyle, its tip an acute spinous point. Inner dististyle with the beak terminating in an acute black spine.

Holotype, ♂, Abitagua, Cunibunda, altitude 1,100 meters, April 2, 1940 (MacIntyre).

Teucholabis (*Teucholabis*) *spica* is related to other Neotropical species of the group having cell *1st* M_2 closed, these including *T.* (*T.*) *angustapicalis* Alexander, *T.* (*T.*) *catharinensis* Alexander, *T.* (*T.*) *inulta* Alexander, *T.* (*T.*) *melanocephala* (Fabricius), *T.* (*T.*) *oteroi* Alexander and *T.* (*T.*) *perangusta* Alexander. It differs from all of the above in the pattern of the body, wings and legs, but especially in the structure of the male hypopygium, notably the bispinous lobe of the basistyle. It is apparently closest to *inulta* yet very distinct.

Teucholabis (Teucholabis) perlata sp. n.

Size large (male, length about 9 mm.); general coloration yellow, the praescutum darkened on anterior portion; a conspicuous black area on dorsal portion of pleurotergite; halteres with yellow knobs; legs black, the tarsi paling to obscure yellow; wings very broad, grayish subhyaline, restrictedly patterned with darker, including a narrow seam along cord; male hypopygium with the arm of basistyle unusually long and slender, sinuous, at apex abruptly narrowed into a black spine; outer dististyle a simple flattened pale blade, gently widened outwardly, provided with numerous black setae on outer portion of distal two-thirds.

Male.—Length, about 9 mm.; wing, 8 x 3 mm.

Rostrum and palpi black, the former relatively short. Antennae black. Head dark-colored.

Pronotum dark. Mesonotal praescutum chiefly dark liver brown, paling to yellow on the posterior interspaces and near the suture, the anterior median portion more intensely darkened to almost black; scutum yellow, the lobes weakly darkened; scutellum and postnotum yellow. Pleura yellow, the pleurotergite with a major black area on dorsal portion; meral region slightly darkened. Halteres with stem dusky, knob light yellow. Legs with coxae and trochanters obscure yellow; femora black, scarcely paler basally; tibiae black; tarsi abruptly paler, obscure yellow. Wings unusually broad, as shown by the measurements; ground color grayish subhyaline, with a very restricted darkened pattern, including the stigma and a narrow seam along the cord; veins brown. Venation: *Sc* long, Sc_1 ending beyond midlength of *Rs*, Sc_2 a short distance back from its

tip; R_2 a little longer than R_{1+2} and subequal to R_{2+3+4}; *m-cu* about three-fourths its length beyond fork of *M*.

Abdomen pale brownish yellow, possibly not fully colored; hypopygium darker. Sternal pockets of male only feebly developed. Male hypopygium with the arm of basistyle unusually long and slender, sinuous, at apex abruptly narrowed into an acute black spine; before this spine, the precipitous portion of the arm provided with delicate setulae. Outer dististyle a simple flattened pale blade, gently widened outwardly, the apex truncated, the outer portion of distal two-thirds with numerous black setae. Inner dististyle with the apical beak blackened and nearly truncated, the usual two points or denticles greatly reduced. Aedeagus at apex produced laterad into a short decurved blackened point.

Holotype, ♂, Abitagua, altitude 1,100 meters, April 14, 1940 (MacIntyre).

The nearest ally of this large and conspicuous species appears to be the very different *Teucholabis* (*Teucholabis*) *mendax* Alexander, which has certain of the structures of the hypopygium of the same general type though differing conspicuously in details. The flattened outer dististyle that is widened outwardly is very unusual in the subgenus. The general appearance of the fly, especially the yellow tarsi, is more like *T.* (*T.*) *flavithorax* (Wiedemann) and relatives but the true affinities appear to be as discussed.

Teucholabis (Teucholabis) distifurca sp. n.

General coloration brown, the praescutum without a differentiated pattern; rostrum long and slender; halteres black throughout; wings with a strong uniform dark brown tinge, the prearcular field more yellow; *Sc* long; abdomen brownish black; male hypopygium with the outer dististyle a blackened clavate structure, at apex bearing two strongly divergent spines of nearly equal size; apical spine of aedeagus small, simple, directed laterad.

Male.—Length, about 5.5 mm.; wing, 5.7 mm.

Rostrum relatively long and slender, nearly as long as remainder of head, black throughout; palpi black. Antennae black; flagellar segments oval, strongly constricted at the incisures, the outer segments more elongate. Head dark brown.

Pronotum obscure yellow, narrowly darkened on extreme lateral portion. Mesonotal praescutum medium brown, without pattern, darker behind, the surface somewhat polished; humeral region a trifle brightened; posterior sclerites of notum brown. Pleura obscure reddish brown, the dorsal region darker, especially before and beneath the wing-root. Halteres black throughout. Legs with the coxae reddish brown; trochanters obscure yellow; remainder of legs broken. Wings with a strong, uniform, dark brown tinge, cell *C* and the prearcular region more yellow; stigma a trifle darker than the ground, oval; veins dark brown, brighter in the prearcular field. Setae of basal costal region long and conspicuous, becoming shorter and more dense on outer portion of vein. Venation: *Sc* long, Sc_1 ending about

opposite three-fourths *Rs*, Sc_2 a short distance from its tip; Sc_1 alone a little longer than vein R_2; cell *1st* M_2 long and narrow, gently widened outwardly; *m-cu* about one-third to one-fourth its length beyond the fork of *M*.

Abdomen brownish black, the basal sternites a trifle brightened; sternal pocket strongly darkened and thus differentiated in color but with relatively few setae. Male hypopygium with the lobe of basistyle straight, the distal third further produced into a glabrous black spine, the lobe basad of this with abundant long yellow setae. Outer dististyle a blackened setiferous club, at apex bearing two strong black divergent spines of nearly equal size. Inner dististyle with the apical beak simple, appearing as a blackened curved blade, the tip acute. Aedeagus with the apical spine small, simple, directed laterad.

Holotype, ♂, Abitagua, altitude 1,100 meters, March 21, 1940 (MacIntyre).

Teucholabis (*Teucholabis*) *distifurca* is very similar in its general appearance to *T.* (*T.*) *atripennis* Alexander, likewise from the Oriente of Ecuador, differing very conspicuously in the structure of the male hypopygium, especially the apical lobe of the basistyle, the entirely different dististyles, and in the apical spine or elongate lobe of the aedeagus. Since the legs of the present fly are broken, it cannot be stated as to whether or not there is any modification of the posterior tibiae as in *atripennis*.

Molophilus Curtis

Molophilus (Molophilus) debilior sp. n.

Belongs to the *plagiatus* group; general coloration brownish black, the lateral portions of the praescutum more reddish brown; antennae relatively long, about one-half the length of body, black throughout; flagellar segments with long outspreading pale setae and unusually long, unilaterally distributed verticils; male hypopygium with the beak of basistyle unusually slender; basal dististyle a small pale rod that narrows to a slender straight spine.

Male.—Length, about 3 mm.; wing, 3.5 mm.; antenna, about 1.4 mm.

Rostrum dark brown; palpi black. Antennae black, relatively long; flagellar segments oval to fusiform, with long outspreading pale setae and much longer verticils that are unilaterally arranged, one to each segment, the longest of these exceeding twice the length of the segment. Head brown.

Mesonotum reddish brown, the central portion of praescutum dark brown or brownish black; posterior sclerites of notum more uniformly brownish black. Pleura brownish black throughout. Halteres blackened, only the base of stem restrictedly paler. Legs with the coxae brownish testaceous; trochanters paler; remainder of legs brownish yellow, appearing much darker because of the abundant black vestiture. Wings relatively broad, strongly suffused with brown, the stigmal region even darker; veins pale brown. Venation: R_2 lying a short distance beyond level of *r-m;* petiole of cell

M_3 less than twice *m-cu;* vein *2nd A* gently sinuous, ending a short distance beyond *m-cu.*

Abdomen, including hypopygium, brownish black. Male hypopygium with the beak of basistyle unusually slender. Both dististyles placed close together at their bases; outer style heavily blackened, the slender arm a little longer than the truncated one, the tip acute. Basal dististyle a small pale rod that is about equal in total length to the outer dististyle but much paler and weaker, with a little more than the basal half widened, thence narrowed to a long straight spine, at the base of the latter with a small tuberculate point. Phallosomic plate relatively narrow, the apex obtuse.

Holotype, ♂, Abitagua, altitude 1,100 meters, March 18, 1940 (MacIntyre).

The general structure of the male hypopygium of the present fly is somewhat similar to that of ***Molophilus* (*Molophilus*) *ductilis*** Alexander, yet the species is very distinct from this and all other described members of the genus.

MONOGRAPH OF THE SOUTH AMERICAN WEEVILS OF THE GENUS CONOTRACHELUS, by KARL FIEDLER. Pages 1–365, 56 figs., 1 pl. (in German), 1940. Published by the British Museum. Price 15s. 0d.

From the preface we quote: "Dr. Karl Fiedler, Sanitätsrat in Suhl, Turingia, first turned his attention to American weevils about the year 1929. After publishing a number of short papers it was suggested to him by Dr. van Emden of the Dresden Museum, that the genus Conotrachelus greatly needed attention." The whole of the undetermined Conotrachelus material in the British Museum, from the time of H. W. Bates' expedition to the Amazons was lent to Dr. Fiedler for examination. He reported on returning the material, that he had described 216 new species and that some 600 species occurred in that region.

In June, 1937, the Trustees agreed to publish Dr. Fiedler's Revision in view of the fact that many of the species are pests on cacao, custard apple, guava, certain legumes, and on stone fruits such as plums and apricots. To avoid inaccuracies of translation it was ordered published in the original German text.

With only five pages of introductory matter the volume plunges directly into taxonomy. The first key divides the genus into six Groups each of which has its key on later pages. The descriptions are short, from one to three (in eleven point type) to a page. Genitalia are not figured, if used at all. The remarkably rich configuration of the surfaces of the beetles, particularly of the elytra takes most of the description space. The illustrations, sixty-five in all, are dorsal views of whole beetles and, except for nine on one plate (frontispiece), are scattered through the text.—C. H. K.

THE INSECT INQUILINES AND VICTIMS OF PITCHER PLANTS IN NORTH CAROLINA

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Pitcher plants have long attracted attention because of their carnivorous habits and their striking unlikeness to any other plants found in this country. It is the purpose of this paper to give the results of studies on the insects and other creatures found in the pitchers.

Because of its availability and abundance, *Sarracenia flava* was the chief species of pitcher plant from which collections were made. Collections were made from this species at Raleigh (May 20 to July 4, October 28, and November 11 in 1938, and May 11 to 30 in 1939), Fayetteville (May 14 to August 3 in 1939, and May 15 to June 27 in 1940), Wilmington (May 15, 1940), Council (May 16, 1940), and Orton (May 2, 1939). The Raleigh locality consisted of a small bog about a quarter acre in size surrounded by a thicket of shrubs, and was well watered by a seepage of springs; there was a good growth of pitchers in this bog, some reaching 54 inches in height. The collections at Fayetteville were made in a bog about four acres in size where the pitchers grew luxuriantly in large round clumps.

Limited collections were made from pitchers of *Sarracenia purpurea* at Raleigh (May 17, 1939), Highlands (August 1, 1938), Pinehurst (May 30, 1938), Hoffman (June 1, 1938), and Southern Pines (June 1, 1938). One collection was made from pitchers of *S. rubra* at Hoffman (June 1, 1938).

The insects and other creatures, whether dead or alive, were taken from the pitchers and put in alcohol, either in the field or after the pitchers had been brought in to the laboratory. Later on the specimens from each lot were sorted out and classified as nearly as possible. No count was made of the number of pitchers collected, but a minimum estimate of five thousand would not be excessive.

Some data were taken on the height of the leaves and the depth of the pitchers in relation to the insects caught, but they were not sufficiently complete to warrant their inclusion in this paper.

LIST OF INSECTS FOUND IN SARRACENIA FLAVA[1]

As the localities where collections were made are few in number, they will be represented only by their initials, followed by the number of specimens taken at each place, as follows: R, Raleigh; F, Fayetteville; W, Wilmington; O, Orton; C, Council.

The list is arranged by orders in their proper sequence.

[1]In order to condense the text, the names of authors of species have been omitted. These names can be found in "The Insects of North Carolina," by C. S. Brimley, 1938, which list has been followed in this paper.

ORTHOPTERA. **Blattidae.** *Cariblatta lutea*, R 11; *Ischnoptera deropeltiformis*, R 1, F 2; *Parcoblatta lata*, R 2; *P. sp.*, C 2; *Parcoblatta* nymphs, R 4; and wings of another cockroach, F 1. **Tettigoniidae.** *Neoconocephalus robustus crepitans* (teneral), R 2; *N. sp.*, F 3; *Atlanticus pachymerus*, R 2; *A. sp.*, R 1; nymphs, R 6. **Gryllidae.** *Nemobius* nymph, R 2. **Acridiidae.** Nymphs, C 1, F 5; *Leptysma marginicollis*, F 1. **Acrydiidae.** *Acrydium sp.*, W 1, C 2; *Tettigidea lateralis*, C 1, F 1.

ISOPTERA. **Termitidae.** *Reticulitermes virginicus*, R 2, May.

NEUROPTERA. **Sialidae.** *Sialis concava*, F 1; *S. sp.*, R 1. **Hemerobiidae.** R 4, F 2. **Chrysopidae.** *Chrysopa oculata*, F 1; *C. rufilabris*, F 6, two alive; *C. sp.*, F 1. **Ascalaphidae.** One larva, F, August.

THYSANOPTERA. One thrips, F, May.

HEMIPTERA. **Cydnidae.** *Galgupha sp.*, R 2, W 1, F 1; *Corimelaena sp.*, R 2. **Pentatomidae.** *Podops cinctipes*, R 4; *Brochymena arborea*, F 1; *B. quadripustulata*, R 1; *Trichopepla semivittata*, R 1; *Mormidea lugens*, R 14, C 2, F 11; *Solubea pugnax*, F 1; *Euschistus servus*, R 2, F 2; *E. tristigmus*, R 11, F 3; *Thyanta calceata*, R 1; *T. custator*, C 4, W 1; *Acrosternum hilare*, R 1; *Podisus maculiventris*, F 1. **Coreidae.** *Acanthocephala terminalis*, F 1; *Leptoglossus oppositus*, R 5, F 2; *Coriscus pilosulus*, R 1; *Harmostes reflexulus*, C 9, F 1; *Corizus bohemani*, R 1; *C. lateralis*, F 1; *C. sp.*, C 2. **Neididae.** *Jalysus spinosus*, R 1, F 1, May. **Lygaeidae.** *Lygaeus bicrucis*, W 2, C 3, F 80; *Nysius californicus*, C 7; *N. sp.*, F 4; *Ischnorhynchus resedae*, R 1; *Geocoris sp.*, R 1; *Oedancala dorsilinea*, R 4; *O. sp.*, C 1, F 6, R 4; *Myodocha serripes*, R 1, F 2; *Orthaea bilobata*, F 5; *O. longula*, R 1, F 9; *O. servillei*, F 1. **Pyrrhocoridae.** *Euryophthalmus succinctus*, F 1. **Tingitidae.** *Corythuca sp.*, R 1. **Reduviidae.** *Oncerotrachelus acuminatus*, R 4, one of which was a nymph; *Stenopoda cinerea*, R 3 nymphs; *Rhiginia cruciata*, R 1; *Fitchia aptera*, C 1; *Sinea spinipes*, R 2; nymphs, R 2. **Nabidae.** *Nabis capsiformis*, W 1, C 1; *N. sp.*, R 1, F 4. **Miridae.** *Neurocolpus nubilus*, R 1; *Adelphocoris rapidus*, R 4, W 1, C 3; *Lygus pratensis*, R 5; other Hempitera, R 3.

HOMOPTERA. **Cercopidae.** *Monecophora bicincta*, R 2, F 1; *Aphrophora sp.*, F 1; *Clastoptera sp.*, R 2. **Membracidae.** *Ceresa brevitylus*, R 1; *C. sp.*, O 16, F 4, R 2; *Stictocephala sp.*, R 19, O 9, C 11, F 5; *Acutalis semicrema*, F 1; *Entylia sp.*, R 1, F 3. **Cicadellidae.** *Oncometopia lateralis*, C 2, F 1; *O. undata*, R 16, W 1, C 2, F 31; *Aulacizes irrorata*, W 1, C 1, F 12; *Graphocephala coccinea*, R 5; *G. versuta*, R 4, C 1, F 11; *Gypona miliaris*, C 1, *G. octolineata*, R 1; *G. sp.*, R 4, C 6, F 8; *Platymetopius frontalis*, R 2; *Euscelis anthracinus*, R 1; *Phlepsius sp.*, R 3, C 3, F 9; *Jassus olitorius*, R 1; unidentified, O 1, F 9, R 41. **Fulgoridae.** *Acanalonia bivittata*, R 1; *Liburniella ornata*, R 1; unidentified, C 3, F 4, R 4. **Psyllidae.** R 1, F 1. **Aphiidae.** R 67, F 13.

COLEOPTERA. **Carabidae.** *Calosoma externum*, F 1; *Leptotrachelus dorsalis*, R 1, F 2; *Galerita sp.*, F 2; *Lebia analis*, R 10, F 23; *L. collaris*, R 2, C 2, F 2; *L. ornata*, R 31, C 1, F 1; *L. scapularis*, F 1, May; *L. viridipennis*, R 2, F 1; *L. viridis*, R 3; *L. sp.*, R 29, C 2, F 6; *Helluomorpha sp.*, F 1; *Harpalus pennsylvanicus*, F 1; *H. sp.*, F 3; unidentified, R 7, W 11, F 16. **Staphylinidae.** *Pinophilus latipes*, R 1; *Staphylinus*

cinnamopterus, R 1; *S. sp.*, R 1; unidentified, R 3. **Histeridae.** R 2, May. **Lycidae.** *Lycostomus lateralis*, F 1; *Eros sp.*, F 1; *Plateros sp.*, C 5, W 3; unidentified, F 1. **Lampyridae.** *Lucidota atra*, R 1; *L. sp.*, O 1; *Photinus pyralis*, R 2; *P. sp.*, R 6, F 1; *Photuris pennsylvanica*, R 7, W 16, F 7, C 3; unidentified, R 1 small species. **Cantharidae.** *Chauliognathus marginatus*, R 281, O 13, W 17, C 9, F 279; *Podabrus rugulosus*, F 1; *P. sp.*, R 12, W 4, C 3, F 19; *Cantharis sp.*, R 79, W 20, C 3, F 113; unidentified, R 35. **Melyridae.** *Collops quadrimaculatus*, F 4. **Cleridae.** *Enoclerus rosmarus*, R 43; *Hydnocera humeralis*, R 7, C 1; unidentified, R 16, F 1. **Oedemeridae.** *Oxacis taeniata*, F 1. **Mordellidae.** R 53, C 1, F 14. **Anthicidae.** *Notoxus sp.*, F 1. **Elateridae.** *Monocrepidius lividus*, R 1, F 1; *M. vespertinus*, C 1, F 8; *Ludius pyrrhos*, R 3; *Orthostethus infuscatus*, F 1; *Melanotus communis*, W 22, C 15, F 1; unidentified, R 12, W 31, C 21, F 37. **Buprestidae.** *Acmaeodera tubulus*, R 1, F 1; *Anthaxia quercata*, F 1; *Agrilus vittaticollis*, R 2; *A. sp.*, R 2; *Brachys ovatus*, R 1, F 5; unidentified, R 1. **Helodidae.** *Helodes pulchella*, F 1; *Prionocyphon discoideus*, R 1; *Ptilodactyla serricollis*, R 9, F 2. **Nitidulidae.** *Carpophilus sp.*, R 1; *Glischrochilus quadrisignatus*, F 2; unidentified, R 2, F 1. **Cucujidae.** *Telephanus velox*, R 2, F 2. **Erotylidae.** *Languria mozardi*, R 1; *Acropteroxys gracilis*, R 1; *Tritoma humeralis*, F 1; unidentified, F 2. **Coccinellidae.** *Hyperaspis gemina*, F 2; *H. sp.*, R 1; *Psyllobora vigintimaculata*, R 2; *Ceratomegilla fusciabris*, R 227, W 3, C 43, F 56; *Hippodamia convergens*, R 4, W 4, C 2, F 16; *Cycloneda munda*, R 111, O 2, W 1, C 4, F 7; *Olla plagiata*, R 1, F 3; *Adalia bipunctata*, R 1; *Chilocorus bivulnerus*, R 2; *Epilachna varivestis*, C 1, F 4; unidentified, R 2, O 2. **Alleculidae.** R 1, O 1, F 1. **Melandryidae.** R 1. **Anobiidae.** R 3. **Scarabaeidae.** *Onthophagus hecate*, R 2; *Aphodius sp.*, R 1; *Dialytes sp.*, F 1; *Serica sp.*, R 5; *Phyllophaga micans*, C 3, F 2; *P. ulkei*, F 2 females; *P. sp.*, R 4, W 12, C 1, F 9; *Euphoria sepulcralis*, R 2, W 1, F 1; *Trichiotinus piger*, R 1. **Cerambycidae.** *Hypermallus villosus*, C 4; *Elaphidion mucronatum*, F 1; *Heterachthes ebenus*, F 2; *Typocerus zebra*, W 2, C 4; *T. velutina*, R 1; *Ancylocera bicolor*, F 1; *Leiopus alpha*, R 1; *Hyperplatys aspersa*, R 2; *Oberea myops*, R 2; unidentified, O 1. **Chrysomelidae.** *Lema sexpunctata*, F 3; *L. sp.*, R 1; *Chlamys gibbosa*, R 4; *Pachybrachys sp.*, R 1; *Bassareus lativittis*, C 2; *Colaspis brunnea*, F 1; *Paria canella*, R 40, O 1; *Galerucella sp.*, R 15; *Diabrotica 12-punctata*, R 33, C 2, F 37; *D. vittata*, R 14, F 5; *Cerotoma trifurcata*, R 101, F 6; *Oedionychis circumdata*, R 1; *O. miniata*, R 1; *O. sp.*, R 32, C 3, F 3; *Disonycha abbreviata*, R 6; *D. caroliniana*, R 1; *D. discoidea*, R 1; *D. leptolineata texana*, R 1; *D. sp.*, F 1; *Haltica sp.*, C 1; *Systena hudsonias*, R 3; *S. sp.*, F 2; Hispinae, R 3; *Chalepus bicolor*, R 1, *C. dorsalis*, F 1; *C. scapularis*, R 1; *Baliosus ruber*, R 3; *Chirida guttata*, R 2; unidentified, R 7, F 3. **Bruchidae.** *Bruchus sp.*, R 1. **Platystomidae.** *Anthribius cornutus*, W 1. **Curculionidae.** *Eugnamptus puncticeps*, C 1; *E. sp.*, R 10; *Attelabus analis*, C 2; *Apion sp.*, F 3; *Otidocephalus sp.*, R 1; *Lixus concavus*, R 2, W 1; *Geraeus picumnus*, R 179, C 7, F 130; *Conotrachelus nenuphar*, R 1; *C. seniculus*, R 5; *C. sp.*, F 3; unidentified, R 3, W 1, C 2, F 5. **Rhynchophoridae.** *Rhodobaenus sp.*, R 2. **Scolytidae.** R 1, F 1. Unidentified Coleoptera, F 28.

MECOPTERA. **Panorpidae.** *Panorpa americana*, R 1; *P. sp.*, R 19, F 8, W 1.

TRICHOPTERA. **Phryganeidae.** *Neuronia postica*, F 2; unidentified Trichoptera from Fayetteville 4.

LEPIDOPTERA. **Satyridae.** *Neonympha eurytus*, R 1; *N. sosybius*, R 1, F 1. **Hesperiidae.** R 1. **Arctiidae.** *Halisidota sp.*, F 1; *Estigmene acrea*, F 1. **Noctuidae.** *Heliothis obsoleta*, F 1; *Feltia annexa*, F 1 alive; *F. sp.*, F 1; *Agrotis ypsilon*, R 2; *Lycophotia margaritosa saucia*, R 2; *Lacinipolia laudabilis*, R 1; *Eriopyga crenulata*, R 1; *Cirphis juncicola*, R 1; *Perigaea sutor*, F 1 alive; *Exyra ridingsi*, R (many of these were found alive as inquilines in the pitchers from mid-May to later on in the fall, even as late as November 11); *Autographa sp.*, R 1 larva; unidentified, R 74 plus 2 larvae, O 2, F 29. **Geometridae.** R 3 larvae found. **Thyridae.** *Thyris lugubris*, R 1. **Pyralidae.** *Desmia funeralis*, R 1. **Aegeriidae.** R 1. Unidentified moths, R 201, W 14, C 33, F 74, O 4; moth larvae, R 1; larvae pitcher plant moths (inquilines), R many, these were very numerous and not all were counted.

DIPTERA. **Ptychopteridae.** *Ptychoptera rufocincta*, F 1; *Bittacomorpha clavipes*, F 1. **Tipulidae.** *Geranomyia rostrata*, O 1, F 15; *Rhipidia domestica*, R 10, *R. maculata*, R 4; *Limonia triocellata*, R 3, F 1; *Erioptera caloptera*, F 2, *E. parva*, F 2; *Gnophomyia luctuosa*, R 1, F 2; *Ormosia innocens*, R 40; *Epiphragma solatrix*, F 3; *Limnophila fuscovaria*, R 2, F 1; *L. luteipennis*, R 2; *L. macrocera*, R 3, F 3; *Tricyphona inconstans*, R 1, O 1, F 7; *Nephrotoma sp.*, R 1, F 1; *Tipula perlongipes*, R 3; *T. sayi*, F 6; *T. tricolor*, R 7, F 10, O 1, W 1; *T. sp.*, R 2; unidentified, R 23, O 6, C 1, F 23. **Culicidae.** R 3. **Mycetophilidae.** *Mycetophila sp.*, R 3, F 12; *Sciara sp.*, R 7, C 1, F 3; *Neosciara sp.*, R 1; unidentified, R 9, O 6, W 1, F 2. **Rhagionidae.** *Chrysopilus sp.*, R 8; *C. fasciatus*, R 1; *C. rotundipennis*, R 3; unidentified, R 1. **Stratiomyiidae.** *Allognosta fuscitarsis*, R 1; *A. obscuriventris*, R 5, W 1; *A. sp.*, R 5; *Hermetia illucens*, R 2, F 3; *Odontomyia sp.*, R 7; *Oxycera albovittata*, F 1; *O. variegata*, F 1; unidentified, F 3. **Tabanidae.** *Chrysops celer*, W 1; *C. flavida*, F 1; *Chrysops sp.*, F 4 males; *Tabanus sp.*, R 1, F 1; *T. pumilis*, F 1. **Asilidae.** *Leptogaster sp.*, R 1; *Asilus sp.*, R 1. **Therevidae.** *Epomyia pictipennis*, F 5; *Psilocephala haemorhoidalis*, R 6, F 4; unidentified, R 2, F 3. **Empididae.** *Syneches rufus*, R 1; *Empis poeciloptera*, F 1; *Rhamphomyia sp.*, F 14; unidentified, R 1, F 2. **Dolichopodidae.** *Sciapus sp.*, R 1, C 1; *Dolichopus sp.*, F 2; unidentified, R 13, O 2, W 2, F 9. **Syrphidae.** *Microdon sp.*, R 1; *Chrysogaster nitida*, R 1; *Toxomerus sp.*, W 1; *Baccha tarchetius*, R 1; *Eristalis tenax*, R 4, F 6; *Xylota pigra*, R 1; *X. sp.*, F 1; *Syritta pipiens*, F 1; unidentified, F 1. **Pyrgotidae.** *Pyrgota undata*, C 1. **Phasiidae.** *Trichopoda radiata*, R 1. **Tachinidae.** *Ormia signifera*, F 1; *Siphona geniculata*, R 1; *Bonnetia comta*, F 1; *Winthemia rufopicta*, W 1; *Euthera tentatrix*, F 1; unidentified, R 2, C 2, F 9. **Dexiidae.** *Thelaira nigripes*, R 1. **Sarcophagidae.** *Neophytoolmaba*, W 1; *Camptopsis miamensis*, R 3; *Sarcophaga sp.*, R 18, W 1 female, F 3; *Sarcophaga* larvae (inquilines) in almost every pitcher; unidentified, R 9, C 4. **Calliphoridae.** *Cochliomyia macellaria*, F 5; *Lucilia sp.*, R 46, F 30. **Muscidae.** *Musca domestica*, R 16, F 2; *Morellia micans*, F 1; *Muscina sp.*, R 3, F 3, C 1. **Anthomyiidae.** R 7, O 2, W 3,

C 8, F 15. **Scatophagidae.** *Parallelomma munda*, R 2; *Achaetella varipes*, R 2; *Scatophaga furcata*, R 1. **Helomyzidae.** F 1. **Sciomyzidae.** *Tetanocera clara*, R 1; *T. vicina*, R 1, F 1; unidentified, R 48, C 1, F 5. **Sapromyzidae.** *Minettia sp.*, R 1; *Sapromyza sp.*, R 1; unidentified, R 6, F 1. **Ortalidae.** *Rivellia quadrifasciata*, F 6; *R. sp.*, R 5; *Camptoneura picta*, R 1, F 4; *Euxesta notata*, F 1; *Chaetopsis fulvifrons*, R 12, F 6; *Stenomyia tenuis*, C 1. **Trypetidae.** *Zonosema electa*, F 2; *Eutreta sparsa*, R 1; *E. sp.*, R 1; *Trypanea actinobola*, C 1; unidentified, R 1. **Sepsidae.** *Sepsis violacea*, R 17, F 4. **Psilidae.** R 1. **Ephydridae.** R 1. **Chloropidae.** *Meromyza americana*, F 1; unidentified, R 1, W 1, F 3. **Drosophilidae.** *Drosophila sigmoides*, R 4; unidentified, R 4.

HYMENOPTERA. **Tenthredinidae.** *Strongylogaster tacitus*, R 1; unidentified, R 24, O 1, W 5, C 2, F 6. **Braconidae.** *Bassus spiracularis*, R 1; unidentified, R 8, W 1, F 2. **Ichneumonidae.** *Amblyteles comptus*, R 1; *A. maurator*, R 3; *A. pullatus*, F 1; *A. signatipes*, R 1; *A.* (near) *tumidifrons*, R 1; *A. w-album*, R 11; *A. sp.*, R 1; *Spilocryptus nuncius*, R 1; *Cryptus sp.*, R 1; *Diapetimorpha orba*, R 1, F 1; *Mesostenus thoracius*, R 1; *Ephialtes aequalis*, R 3; *E. conquisitor*, W 1; *Diplazon laetatorius*, R 2; *Eremotylus arctiae*, R 1; unidentified, R 56, W 2, C 11, F 22. **Cynipidae.** *Amphibolips sp.*, R 1; unidentified, R 1, C 1, F 3. **Perilampidae.** R 2. **Chalcididae.** *Spilochalcis mariae*, C 1; other chalcids, F 10, R 26. **Formicidae.** *Crematogaster sp.*, R 1567, O 6, W 1000 plus, C 1000 plus, F 6; *Camponotus castaneus*, C 1, F 4; unidentified, R est. 871, O 3, F est. 90. **Psammocharidae.** *Ageniella accepta*, F 2 (one male); *A. iridipennis*, R 1; *Pseudagenia architecta*, R 2; *P. caerulescens*, F 1; *P. mellipes adjuncta*, R 3, F 1; *Priocnemis sp.*, F 1; *Planiceps niger*, C 2; *Pedinaspis legatus*, W 2 males, C 2 males and 2 females; *Episyron snowi*, F 1; *Psammochares sp.*, R 4; *Sericopompilis posticatus*, C 1; *Lophopompilus atrox*, F 1; *Pompiloides sp.*, F 1; *Nannopompilus argenteus*, R 1, C 8; unidentified, R 11. **Chrysididae.** *Notozus sp.*, R 1; *Chrysis tridens*, F 1; *C. sp.*, R 1, W 1; unidentified, R 3, F 1. **Tiphiidae.** *Myzine sp.*, W 1, F 1 male; *Tiphia sp.*, R 5, W 11, F 3 females. **Mutillidae.** *Timulla sp.*, F 1 male. **Vespidae.** *Ancistrocerus sp.*, R 1; *Odynerus megaera*, R 1; *O. sp.*, R 2, F 2; *Polistes annularis*, R 3; *P. fuscatus*, R 12; *P. hunteri*, R 2; *P. rubiginosus*, R 3, F 1; *P. variatus*, F 2; *P. sp.*, C 1; *Vespula maculifrons*, R 4; *V. squamosa*, R 1, F 1 queen. **Sphecidae.** *Tachytes sp.*, F 2; *Trypoxylon sp.*, R 1; *Chlorion harrisi*, R 3; *C. ichneumoneum*, F 1; *Sphex nigricans*, F 1; *S. urnaria*, R 2, F 1; *Sceliphron cementarium*, R 5, F 1; *S. cyaneum*, R 2, F 1; Pseninae, R 1; Nyssonini: *Didineis texana*, R 1; *Paramellinus sp.*, F 4; other Nyssonini, C 1, F 1; Bembecini: *Stictia carolina*, F 1; Crabronini: *Crabro sp.*, R 3, F 1. **Halictidae.** *Augochlora fervida*, R 1; *A. sp.*, R 33, W 1, C 1; *Halictus sp.*, R 2. **Megachilidae.** *Osmia sp.*, R 1. **Bombidae.** *Bombus sp.*, F 3. **Apidae.** *Apis mellifica*, R 8, W 1, F 32; other bees, R 29, C 5, F 6.

ARACHNIDA. ARANEAE. The Spiders. **Argiopidae** (Orb weavers). *Marxia stellata*, R 3. **Tomisidae** (Crab Spiders), R 2. **Attidae** (Jumping spiders), R 3. Unidentified spiders, R 166, W 6, C 15, F 31. OPILIONES. The harvestmen. R 13, F 2; unidentified, R 1. ACARINA. Mites were taken in pitchers at Orton (5) and at Fayetteville (1).

MOLLUSCA. Two small snails were taken at Raleigh in May, one being partly digested including the shell (May 19, 1939).

AMPHIBIA. Two small frogs, *Pseudacris ocularis* and *Hyla cinerea*, were taken alive in pitchers at Orton, May 2, 1939.

COLLECTIONS FROM SARRACENIAS OTHER THAN FLAVA

Limited collections were made from *S. purpurea* and *S. rubra* but the material obtained was not sufficient to furnish enough data to draw any general conclusions. The material from these two forms was as follows, listed under the head of the respective localities.

SARRACENNIA PURPUREA AT HIGHLANDS, N. C.

August 1, 1938

ODONATA. One Libellulid nymph, the only specimen of the order obtained in all our collecting, COLEOPTERA. Four Carabids, including one *Sphaeroderus*; two Coccinellids, one of them *Ceratomegilla fuscilabris*, and the other *Hippodamia convergens*; two Elaterids; and three Scarabaeids, all *Trichiotinus affinis*. TRICHOPTERA. All four wings of a large caddis-fly. DIPTERA. One small specimen. HYMENOPTERA. A sawfly wing; Ichneumonid wing; one dealate female of the carpenter ant; and 20 winged specimens of other Formicine ants. ARACHNIDA. Two Phalangids. MOLLUSCA. One snail.

SARRACENIA PURPUREA AT PINEHURST, N. C.

May 30, 1938

ORTHOPTERA. One *Cariblatta lutea* and pieces of a grasshopper. DIPTERA. One dozen larvae of *Wyeomyia smithii*, and 20 of *Sarcophaga sp.*, all alive and all inquilines. HYMENOPTERA. One wing of *Polistes* wasp; a queen and 8 workers of *Crematogaster*, 4 winged *Camponotus castaneus*, and 21 other ants, and a single Bethylid. ARACHNIDA. Three spiders.

SARRACENIA PURPUREA AT HOFFMAN, N. C.

June 1, 1938

HEMIPTERA. One each of *Podops cinctipes*, *Cymus angustatus*, and *Antillocoris pilosulus*. COLEOPTERA. Two *Chlaenius*, and a single *Helops cisteloides*. DIPTERA. Three *Sarcophaga* larvae, a number of mosquito larvae (*Wyeomyia smithii*), and a number of other dipterous larvae, all living and all inquilines. Also about 75 *Drosophila repleta*, victims. HYMENOPTERA. A Braconid and a Psammocharid wasp. ARACHNIDA. One *Lycosa scutulata*.

SARRACENIA PURPUREA AT SOUTHERN PINES, N. C.

June 1, 1938

COLEOPTERA. One *Diabrotica 12-punctata*. HYMENOPTERA. One *Camponotus castaneus* and one other ant.

SARRACENIA PURPUREA AT RALEIGH, N. C.
May 17, 1939

ORTHOPTERA. One *Cariblatta lutea* and one cockroach nymph. HEMIPTERA. One each of *Mormidea lugens* and *Myodocha serripes*, and one of another species. HOMOPTERA. One *Monecophora bicincta*. COLEOPTERA. One Mordellid, one Elaterid, one *Chauliognathus marginatus*, one *Languria mozardi*, one Coccinellid larva, and two *Geraeus picumnus*. HYMENOPTERA. One *Camponotus castaneus* and 15 *C. pennsylvanicus*, and 25 other ants. Inquilines, six larvae of *Wyeomyia smithii* and one *Sarcophaga* larva.

SARRACENIA RUBRA AT HOFFMAN, N. C.
June 1, 1938

COLEOPTERA. Four *Ceratomegilla fuscilabris*, two *Diabrotica* 12-*punctata*. DIPTERA. An adult mosquito, a *Sciara*, a living *Sarcophaga* maggot, and five *Drosophila sp.* HYMENOPTERA. An Ichneumonid and the remains of a bee.

DISCUSSION

On May 2 the pitchers had just started catching insects, as only a few were found, and some pitchers contained none. A lot gathered on July 3 showed that they had about finished catching, the few insects found at that date probably being due to accidental trapping in the pitchers. It would thus appear that the pitchers are functioning as insect traps from the middle of May until the last of June; after June most pitchers contained principally a disintegrating mass of insect remains, very little of which was identifiable. Earlier in the season the insects caught were in a comparatively good state of preservation, and occasionally specimens were found alive, thus indicating that they had recently entered the pitchers. Strong action is exerted on the insect by the pitcher plant fluid, and this becomes more profound as the season advances. The strength of the fluid is shown by the finding of a partly digested snail shell in one of the pitchers.

The insects entering the pitchers may be divided into three classes:

1. Those that find a home therein, comprising mainly the larvae of the pitcher plant moth (*Exyra ridingsi*), certain species of *Sarcophaga* larvae, and though not in the pitchers of *Sarracenia flava*, but in those of another species, *S. purpurea*, the larvae of a certain mosquito (*Wyeomyia smithii*). The moth larvae live on the tissues of the pitchers, *Sarcophaga* larvae on the dead and disintegrating insects found at the bottom of the pitchers, and the *Wyeomyia* larvae presumably on the infusoria in the water. Adult moths of *E. ridingsi* are often found resting just within the pitchers, and when disturbed usually retire further down them.

2. Regular visitors, namely, those forms that are found in sufficient numbers in the pitchers to indicate the probability that they are attracted to them by the odor of the fluid secreted by the pitchers or possibly in some cases by the odor of the decaying insects.

3. Accidentals, found in small numbers only, thus indicating that

their presence in the pitchers is presumably merely accidental, but of course it may also be due to the scarcity of said insects in the neighborhood of the pitchers. Naturally no hard and fast line can be drawn between groups 2 and 3.

In summarizing the results we find that the following orders are not represented at all: Thysanura, Collembola, Ephemerida, Plecoptera, Corrodentia, Mallophaga, Anoplura, Dermaptera, Strepsiptera, and Siphonaptera.

Taking up the orders in their proper sequence, we find that in the Orthoptera no species seems to be actually attracted to the pitchers, except possibly the roach, *Cariblatta lutea*, which is represented by 11 specimens taken at Raleigh from late May to mid-June. The other species seem to be purely accidental in occurrence.

The Isoptera are represented only by two winged specimens of *Reticulitermes virginicus* taken at Raleigh in late May.

The Neuroptera are represented by only scattered specimens, for which see preceding list in this article.

In the Hemiptera the Pentatomidae are represented principally by 14 *Mormidea lugens* from Raleigh, and the same number from Fayetteville, 11 *Euschistus tristigmus* from Raleigh and three from Fayetteville. The Lygaeidae are represented by *Lygaeus bicrucis*, 80 from Fayetteville, and a few from Wilmington and Council, which makes it by far the most frequently found hemiptron. Representatives of the other families seem to be merely scattering, such common species as *Lygus pratensis* and *Adelphocoris rapidus* being represented by less than a dozen specimens.

In the Homoptera it is interesting to note that at Orton 16 specimens of a *Ceresa* were taken which comprised the bulk of insects collected in one small lot. The most numerous Membracid was a *Stictocephala* of which 19 were taken at Raleigh, 15 at Fayetteville, and 9 at Orton. The commonest Cicadellid was *Oncometopia undata*, 16 at Raleigh, 31 at Fayetteville, and three elsewhere.

In the Coleoptera the catch of Carabids was wholly scattering except with regard to the genus *Lebia*, in which *L. ornata* is represented by 31 at Raleigh and three at other places, and *L. analis* by 23 at Fayetteville and ten at Raleigh. Other Lebias were also taken in smaller numbers, namely *Lebia collaris* 6, *L. scapularis* one at Fayetteville which was new to the state collection, *L. viridipennis* three, and *L. viridis* three. The small number of the last species is noteworthy because it is the commonest in general collecting. Nothing further merits notice until we get to the family Cantharidae which is represented by more specimens than any other family in the whole collection, 281 specimens being taken at Raleigh of *Chauliognathus marginatus* and 279 at Fayetteville. The genus *Podabrus* is represented by 12 specimens at Raleigh and 19 at Fayetteville and several elsewhere. *Cantharis* shows up with 110 specimens at Fayetteville including a large series of the rare *C. cruralis* and 79 more *Cantharis* at Raleigh and 20 more at Wilmington.

Enoclerus rosmarus takes the lead in the Cleridae with 50 specimens taken at Raleigh and none elsewhere, this fully trebling the number of specimens of that species in our collection. Fifty-three unidentified

Mordellidae were taken at Raleigh and 14 at Fayetteville. Of the Elateridae one day's collecting at Wilmington furnished 31 specimens, another at Council 21, and a third at Fayetteville 28. Of these there were 22 *Melanotus communis* taken at Wilmington, 15 at Council, and one at Fayetteville. There were only a few specimens of *M. communis* taken elsewhere. Nothing worthy of note is of interest until we come to the Coccinellidae. In this family *Ceratomegilla fuscilabris* turns up with 227 specimens at Raleigh, 56 at Fayetteville, and 43 at Council. *Cycloneda munda* is also well represented by 111 at Raleigh and several elsewhere. It is rather curious that *Hippodamia convergens*, a still commoner species, is only represented by 24 specimens in the whole collection. Nothing further of special interest occurs in the Coleoptera until we reach the Scarabaeidae, where it is worthy of note that some of the largest species of Phyllophaga were found sparingly in the pitchers. The Chrysomelidae were represented by 101 *Cerotoma trifurcata* at Raleigh, 33 *Diabrotica 12-punctata* at Raleigh and 37 at Fayetteville, 40 *Paria canella* taken at Raleigh. Last of all the Curculionidae are represented by scattered specimens of several species but the common little *Geraeus picumnus* shows evidence of liking the pitchers as 179 turned up at Raleigh and 120 at Fayetteville.

In the Trichoptera two specimens of *Neuronia posticata* were collected at Fayetteville, and this happens to be the only caddis fly that comes to sugar.

Coming now to the Lepidoptera the first thing to note is the scarcity of butterflies, none of the large or medium sized species being found. A single specimen of *Neonympha eurytus* taken at Raleigh, and one of *N. sosybius* at Raleigh and another at Fayetteville, and a single unidentified skipper at Raleigh make up the entire list.

Among the moths we found plenty of specimens, about half of them Noctuids, but very few were in good enough condition to determine. The pitcher moth, *Exyra ridingsi*, and its larvae were often found alive in the pitchers.

One of the interesting catches in the Diptera was the Tipuloid, *Ptychoptera rufocincta*, of which one taken at Fayetteville was the only one in our collection. Among the Tipulids quite a number of species were represented of which the following may be mentioned, *Geranomyia rostrata*, 15 at Fayetteville and one at Orton, *Rhipidia domestica*, 10 at Raleigh, and 40 of the tiny *Ormosia innocens* at the same place.

Of the Tabanidae only a few scattered specimens were taken, but two males of *Chrysops sp.*, from Fayetteville had uniformly dusky wings and so far remain undetermined. In the Empididae not many were taken, but one from Fayetteville was *Empis poecilоptera* new to the state collection. *Sarcophaga* larvae feeding on the remains of insects were found in nearly every pitcher examined but we had absolutely no success in rearing any. In the Calliphoridae species of *Lucilia* were evidently attracted to the pitchers by the odor of decaying insects; 46 were taken at Raleigh and 30 at Fayetteville.

It is of interest to note that among the Hymenoptera about 80 Ichneumonids were taken at Raleigh, 25 at Fayetteville, and 11 at Council. Most of them were unidentified, but the largest number of

any single species identified was *Ichneumon w-album* of which 11 were taken at Raleigh.

Nothing further of interest occurs until we come to the ants, and the most prominent genus represented was *Crematogaster* which is represented by over 1500 specimens taken at Raleigh and over 1000 each at Council and Wilmington. The number of these can reasonably be accounted for by the fact that a colony was in the vicinity of the pitchers, and the unhappy members were attracted to the pitchers for their destruction. Possibly a thousand other ants were taken at other places. The Psammocharidae were represented by about a dozen species, mainly by only a few specimens each. Of these *Ageniella iridipennis* from Raleigh and *Sericopompilus posticatus* from Council were new records for the state. *Pedinaspis legatus* was represented by two very undersized females from Council and two males each from the same locality and Wilmington. None of the others were of special interest.

Other wasps were represented by scattered examples only and the same may be said of the bees as well.

About 200 spiders were taken, nearly all unidentified, together with a few harvestmen, as well as an occasional snail. It may be noted that the juices of the pitcher plants were capable of dissolving a snail's shell, one of which was partly dissolved.

Two small frogs were taken resting inside the pitchers at Orton, May 2, 1939.

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BOOK NOTICES

OUTLINES OF ENTOMOLOGY, by A. D. IMMS. Pages vii and 184, 96 figs., 1942. Size 5½x8¾ inches. Published by E. P. DUTTON AND COMPANY, INC., 300 Fourth Ave., New York City. Price, postpaid, $3.75.

This handy small volume shows the impress of total war. "This book is produced in complete conformity with the authorized economy standard." "The book is intended for anyone who wishes to acquire an elementary knowledge of entomology as a branch of general zoology. It is written especially for the student embarking upon a university training in zoology or agriculture in preparation for a career. . . . It represents the author's ideas on the fundamentals of the subject and is based upon nearly forty years of experience at home and abroad."

Professor Imms is Reader in Entomology and Fellow of Downing College of Cambridge University. He is late Chief Entomologist of the Rothamsted Experimental Station, known as the premier agricultural experimental station in the world; and he was formerly Forest Zoologist to the Government of India.

The material is arranged as follows: Part I. Introduction, pp. 1–5; II. Anatomy and Physiology, pp. 6–78; III. Embryology, Growth and Metamorphosis, pp. 79–97; IV. Nomenclature and Classification, pp. 98–166; V. Relationships of Insects, pp. 167–176; Index, pp. 177–184.

There is no padding in Outlines of Entomology. It is the most condensed statement of the many and very diverse forms of insect structure, function and habits which we have seen. The illustrations are well chosen, large enough to be comfortable to the eye of the reader and are well labeled. It is an extreme condensation of the type of material Imms used in "A General Textbook of Entomology," and in the two editions of "Recent Advances in Entomology.—C. H. K.

SYSTEMATICS AND THE ORIGIN OF SPECIES, by ERNST MAYR, 1942. Pages xiv and 334, 14 tables, 29 text figures. Size 9¼x6 inches. Published by the COLUMBIA UNIVERSITY PRESS, 2960 Broadway, New York City. Price $4.00, postpaid.

From the author's Preface: "During the past fifty years animal taxonomy has undergone a revolution almost as fundamental as that which occurred in genetics after the rediscovery of Mendel's laws. The change from the static species concept of Linnaeus to the dynamic species concept of the modern systematist has not entirely escaped the attention of progressive students of genetics and evolution. However, the significance of polytypic species, of the phenomena of geographic and other forms of isolation are by no means as widely appreciated among students of evolution and even among taxonomists as they deserve."

"Dr. Mayr is an outstanding systematist; his specialty is ornithology, and he is the foremost authority on the birds of Oceania and Indonesia" (Th. Dobzhansky). The latter is an entomologist who finally entered the genetics laboratory and dragged Drosophila into the field where its many species live under natural conditions. He states further: "Dr. Mayr's chief accomplishment in this book has been to correlate the evidence and the points of view of modern systematics with those of other biological disciplines, particularly genetics and ecology."

The volume is devoted entirely to a discussion of the present day species concept, an evolving population rather than a static finally describable form. His shorter definition is: "Species are groups of actually or potentially interbreeding natural populations which are reproductively isolated from such other groups." He covers the following topics: I. Methods and Principles of Systematics; II. Taxonomic Characters and Their Variation; III. Geographic Variation; IV. Some Aspects of Geographic Variation; V. Systematic Categories and the New Species Concept; VI. Polytypic Species; VII. Species in Evolution; VIII. Nongeographic Speciation; IX. Biology of Speciation; X. Higher Categories and Evolution.

The work is very closely documented and with a sixteen page bibliography, *with titles*. He has few kind words for the systematist whose whole ambition is to

perpetuate his name on another new species, and his comments on "aberrations"! By definition of "aberration" all individuals of *Homo sapiens*, each and all, are aberrations. Why not describe them and name them? He recognizes the almost unbelievably great task facing taxonomists in entomology with a million or more unnamed species to be studied and defined. He comforts us by pointing out that the only way we can dig out is to use the earlier concept of static or near static species until that time when distributions and interrelationships are known in more detail. Entomologists will still have to rely on experience, judgment and hard work.

Mayr is one of the men in charge of the great Lord Rothschild collection of birds recently purchased by the American Museum of Natural History which, with the Museum's own collection of North and South American birds, makes that institution's collection the greatest in the world. The distribution, speciation and interrelationships of birds are better known than those of any group of animals unless those of Lepidoptera. Dr. Mayr knows bird species and species distribution. He is in a position to write with authority.—C. H. K.

ON THE PREPARATION AND PRESERVATION OF INSECTS, with particular Reference to Coleoptera, by J. MANSON VALENTINE. Pages 1-16, 1942. Published in Smithsonian Miscellaneous Collections, Vol. 103, No. 4.

The ANNALS has little space for notice of items of sixteen pages. But, the present high quality of well illustrated taxonomic articles offered to the ANNALS has come from no editorial policy or ruling but from the steady development of taxonomic technique. All species that can be so described are differentiated on genitalia, usually those of the male but at times those also of the female. These characters appear to be good in a great many groups. However they fail in a few. In our common ants with physiological (social) species genitalic characters for species determination are of little value. In many non-social forms of Hymenoptera the remarkable work of such as that of Murray on Sphex has shown the necessity of a minute study of genitalia. Only a first class technique of preparation and first class drawings of genitalia can give us the full advantage of our increasing knowledge in taxonomic entomology. How many times have we heard: "One good figure is equal to two pages of text," in the exact determination of a new species (or the correct placement of an "old" species).

This pamphlet gives us an exacting and powerful technique for the study of small beetle species. It has been written with wide advice from the experts in Federal taxonomic work on beetles.—C. H. K.

STRAIGHT AND CROOKED THINKING, by ROBERT H. THONLESS, 284 pages. 1930. 4½x6½ inches. Published by HODDER AND STOUGHTON, LTD., London.

Few books have interested us in recent reading as has this pocket volume. We are calling the attention of all those who wish to guard against certain types of faulty reasoning in their own expository writing. Those who will enjoy it most are the reader-critics whose greatest pleasure is found in the faulty thinking of others. If Thonless' volume were required in deliberative (?) bodies of politicians as is Robert's "Rules of Order" it would wreck much political argument from city councils and police courts to Congress and the League of Nations. The book is ammunition in a parlor discussion but is veritable castor oil to the rabble raiser. All individuals who act on the assumption that they can think will enjoy Straight and Crooked Thinking. The volume is a masterpiece of lucid exposition.

Contents: Emotional Meanings; All and Some; Dishonest Tricks in Argument; Logical Fallacies; Tricks of Suggestion; Habits of Thought; Tabloid Thinking; Pitfalls in Analogy; On Drawing the Line; Vagueness; Prejudice; Need for Straight Thinking.

Appendix: Thirty-four Dishonest Tricks; A Discussion Illustrating Crooked Thinking.—C. H. K.

INTRODUCTION TO APPLIED ENTOMOLOGY, by WILLIAM J. BAERG. Pages i-vii plus 1-146. 128 figures. 1942. Second edition, Published by BURGESS PUBLISHING COMPANY, Minneapolis, Minn. Price $2.25.

This new edition is a great improvement over the first edition which appeared under the title "Introduction to Economic Entomology" in 1937.

Many parts of the book have been almost entirely re-written. The latest control measures and life history data have been incorporated under the discussions of each pest. The pests are taken up from the classification or systematic viewpoint. The addition of 128 original illustrations is also a very great improvement over the first edition. These appear in most cases to have been well done.

As in the first edition only the most important pests are considered and special emphasis is given to those which are problems of the southern United States. The other classes of Arthropods which have some economic bearing on man are treated prior to the sections on insect morphology, metamorphosis, and artificial control. A discussion of all the natural controls, in my opinion, would be a valuable addition. Following the discussion of each pest or group of pests, a selected list of references is given. This volume has also the addition of an index.

With all of these improvements, a wider use of this text appears to be definitely assured.—R. H. DAVIDSON.

INTRODUCTION TO PARASITOLOGY, by A. S. PEARSE. ix+357 pages; 448 illustrations. C. C. THOMAS, Springfield, Ill. 1942. Price $3.75.

This new book of animal parasitology is a brief account of those members of the animal kingdom that live in or on other animals. Therefore, the parasitic fauna of man and the domestic animals is not emphasized and it is pleasing to see the large amount of information that could be included only in a book written from the purely zoological point of view. In addition to protozoa, worms, and arthropods, which are the stock and trade of the parasitologist, there are excellent accounts of parasitic and consortic mesozoans, sponges, coelenterates, ctenophores, rotifers, annelids, molluscs, and chordates.

One-third of this volume is about arthropods. Insects, including those used in the biological control of insect pests, receive generous treatment. For general reading and for students of entomology, zoology, and wildlife conservation this book can be whole-heartedly recommended. Some excellent features are the simplicity and concreteness of presentation; chapters on methods, and numerous uniform and excellent illustrations which are taken from original sources.

—C. E. VENARD.

ON GROWTH AND FORM, by D'ARCY WENTWORTH THOMPSON, New Edition, 1942. Pages 1-1116, 554 text figs., 2 pls. and many tables. 5¾x8¾ inches. Published by the CAMBRIDGE UNIVERSITY PRESS (Cambridge, Eng.) and THE MACMILLAN COMPANY, 60 Fifth Ave., New York City. Price $12.50.

The first edition of Growth and Form appeared in 1917. The author, Sir D'Arcy Thompson, Professor of Natural History at Saint Andrews University, Dundee, Scotland, has been an international figure on various British and International Commissions that sat on marine fisheries problems. He was Lowell Lecturer at Harvard in 1936 and is a member of the most famous of all clubs of distinguished intellectuals, The Athenium of London.

Since Darwin's assumption of a tight fit of animal form in its environment as a matter of survival, biologists have been more or less interested in the problem of form. How did the animal acquire its form? Why might a whole genus of organisms all in nearly equal environments show a variety of distinct forms? Why do we find the startling change in form from seed to flowering form of many plants which do not shift environments as the plant form changes?

Thompson starts with cells, the building blocks of which living forms are constructed. He points out their physical limitations and the limitations of form imposed by the limitations of the material. His volume is a detailed discussion of organic form from the point of view of the physicist. He employs their formulae of stresses, strains, limits and space relationships.

Unfortunately the majority of biologists are raised on studies of function. They enter a life study of biology from organic chemistry, physiology and biomathematics which are the most useful tools in their particular fields. Unfor-

tunately for such education, form and function are indissolubly integrated. In life one cannot exist without the other. The chemists have come to recognize this great gap in chemical studies. They have developed physical-chemistry which by the morphology of molecules helps explain crystals, elasticity and colloidal phenomena and other specific chemical activity. The biologists have found function such a complex and profitable field the majority have not taken time to use even simple physical theory and techniques.

Because the field of physical biology has been so neglected the research on its problems is widely scattered and much is buried in physical literature. We recall many articles on vision in optical journals, on form in physical publications. Thompson has brought these opening studies together and has amassed data in a convincing argument that here we have a bio-physical field scarcely known at present and from the scattered facts and immature techniques used, a vast field which is yet in its infancy.

Some of the topics: Magnitude; Rate of Growth; Internal Form and Structure of the Cell; Adsorption; Forms of Tissues; Concretions, Spicules; The Equiangular Spiral; Shapes of Horns, Teeth, with a Note on Torsion; Leaf Arrangement; Shapes of Eggs; Form and Mechanical Efficiency; Theory of Transformations or the Comparison of Related Forms.

On Growth and Form is a masterly review of a rich but almost unexplored field of biology which touches taxonomy, species distinctions, embryology, adaptation to environment and other basic biological problems, on a study of the details of which entomologists make their living and taxes.

On another page of these Annals is noticed the recent work by Joseph Needham, the British embryologist and organic chemist. We glory in the thought that our country has as an ally a country whose great universities can produce such additions to and summaries of knowledge while under pressure of a total war.

—C. H. K.

GUIDE TO THE LITERATURE OF THE ZOOLOGICAL SCIENCES, by ROGER C. SMITH, pages vii and 123, 1942. Mimeograph, cartridge paper covers, 8½x10¾ inches. Published by BURGESS PUBLISHING CO., 426 South Sixth St., Minneapolis, Minn. Price, $2.00.

The present guide covers zoological literature because of which wide coverage it is not as detailed for the field of entomological literature as many entomologists might desire. For the very same reason it will be of more value to the entomologist in the exploration of borderline fields than would be a more strictly limited entomological guide. With several good review journals in the field of entomology as well as a good guide to literature, Professor Smith was wise in choosing the field he has covered. Further, the volume will be of wide use among zoologists.

The eight chapters are: I. Mechanics of the Library; II. Bibliographies of the Zoological Sciences; III. Abstract Journals; IV. The Form of Bibliographies; V. The Forms of Literature; VI. Preparation of a Scientific Paper; VII. Taxonomic Indexes and Literature; VIII. Library Assignments.

On page 94 under an inconspicuous subtitle are given the basic assumptions on which the work is based; the subtitle reads "Reasons for Writing Scientific Papers." The first three given are: "a. To record results of scientific research; b. To establish priority on a phase of the subject; c. To report on a phase of a problem to assist other workers in the same field." We would have placed item "c" first and have discarded the other five items. The reviewer teaches a similar course and teaches that scientific writing to be good and of real value must be for the reader. In editorial work we sometimes suspect authors of writing to advertise. Usually an article by such shows a selfconsciousness which detracts from its effectiveness as a building stone in the edifice of science. Too often such a point of view leads the scientific man to shallow, hasty work and superficial exposition. He jumps forward to another title listed in his bibliography. He overlooks and leaves sound methods behind him.

On the bottom of the same page (94) the author himself, in subheads (3) and (4) on how to compose a title, develops the point of view that writing is for the reader.

Chapter VIII, Library Assignments, will help some teachers. We prefer to have the student actually write a publishable paper, one which requires consid-

erable library work. To get the habit of productivity the student must be put on his own. We do not approve of professor-student authorship. The student should be in position to take full pride in his own accomplishment. If he does, he may repeat the experiences of being personally productive. The professor's duty is to guide, not give too much and certainly not to take from the developing ego of the beginner. One has to take pride in his work to keep it up to perfection, and has to learn the pleasure to himself from bestowing pleasure on others in his field.

The lack of "banner" page heads reduces ease of use but even more does the lack of space for the chapter heads and major chapter subheads. Each of the many subheads looks too much like the others for the eye to pick up the important, guiding major heads. A few additional pages to spread the format would have made a work much more usable. Print format cannot be condensed except to the disadvantage of the reader; remember, we are writing for the comfort of the reader.

We do like the historical notes so freely given when listing famous journals. The history of our science is slipping by all too much unrecorded. Professor Smith has given us a volume that will be of repeated use in every biological library and in every productive biological laboratory.—C. H. K.

BIOLOGICAL SYMPOSIA, VOL. VIII. Levels of Integration in Biological and Social Systems, (articles by twelve authorities). Edited by JAQUES CATTELL, 1942. Pages 1–240. 7x10 inches. Published by THE JAQUES CATTELL PRESS, Lancaster, Penna.

The papers included in this volume form a symposium held in September, 1941, in connection with the celebration at the University of Chicago of the fiftieth anniversary of the University.

We have among insects some of the most amazing and highly evolved societies known to man. With these we find a great series of "semisocial" insects in all degrees of social development. This area of entomology is one of the richest fields for the study of the elemental factors and relationships of animals to each other when the species passes into a social organization.

The problems of integration in biological systems from colonial Protozoa to man are discussed in eleven elaborate papers and from several points of view Professor Thomas Park discusses Integration in Infra-Social Insect Populations. Professor A. E. Emerson discusses Basic Comparisons of Human and Insect Societies.—C. H. K.

THE GENUS CONOTRACHELUS DEJEAN (COLEOPTERA, CURCULIONIDAE) IN THE NORTH CENTRAL UNITED STATES, by HERBERT FREDERICK SCHOOF. Illinois Biological Monographs, Vol. 19, No. 3, pp. 1–170, 9 plates, 1942. The UNIVERSITY OF ILLINOIS PRESS, Urbana, Ill. Price $1.50.

This is a monograph of the 28 species of *Conotrachelus* now known to occur in the states of Illinois, Wisconsin, Iowa, Missouri, Kentucky and Indiana. Five of these forms are new to science. The description of a new species not known to occur in the area is presented as an addendum. Keys are given for four groups which have been reduced from six, as well as keys to the species.

Importance of morphological structures is evaluated, including a detailed account of the male genitalia of *C. nenuphar* (Hbst.). Uncus, mesoscutellum and metasternal grooves are used as characters.

A detailed account of methods used in removal, study and preservation of male genitalia is given. The author uses the terms lectotype, lectoparatype, neotype, neoallotype, neoparatype and plesiotype.

This paper should be a considerable aid in identification of the members of this genus occurring in the upper Mississippi region.—J. N. KNULL.

THE MUSCULATURE OF THE LABRUM, LABIUM AND PHARYNGEAL REGION OF ADULT AND IMMATURE COLEOPTERA, by CARL KESTER DORSEY, pages 1–42, 24 pls. with 134 figs. 1943. Published as Vol. 103, No. 7, of Smithsonian Miscellaneous Collections, Smithsonian Institution, Washington, D. C.

The object of this study was to determine how a chewing insect handled food in its cibarium and particularly how it brought food to the true mouth at the anterior end of the pharynx. The work was done at the University of Maryland under the supervision of Professors Snodgrass and Cory. The many illustrations are well drawn so that they explain the text in a clear manner. Twenty-two families are represented in the study. In each case larva and adult had been carefully identified as of the same species by the taxonomists of the Bureau of Entomology and Plant Quarantine. Thus the work bears the checks and imprint of high authority.—C. H. K.

FIELDBOOK OF NATIVE ILLINOIS SHRUBS, by LEO R. TEHON. Manual 3. 1942. Pages 1–307, 172 figs., map and 4 col. pls., 4½x7½ inches, hard cloth bound. Published by ILLINOIS NATURAL HISTORY SURVEY, Urbana, Illinois. Price, postpaid, $1.25.

This pocket manual keys out, describes and states distribution of 210 species and 27 varieties of shrubby plants found in Illinois. One-hundred-seventy-two of them are figured in black and white and six in colors.

The descriptions are in simple terms for which there is a glossary. The use of the books implies a small knowledge of plant anatomy.

Doctor Tehon has been in charge of the Survey's Section of Applied Botany since 1922. Adapting the material to the format of the Survey's manual series was the work of James S. Ayars, Technical Editor. The excellent line drawings are by Miss Kathryn M. Sommerman. The colored photographs are by Ray H. Hamm, University of Illinois photographer, by Dr. Tehon and by Editor Ayars.

The beautiful illustrations make the manual of use to the general public. The keys are very simple but are still probably beyond the patience of the casual user. The problem is that we have too many plants.—C. H. K.

THE TALE OF THE PROMETHEA MOTH, by HENRY B. KANE. About 40 pages (not numbered), 7x9 inches. 1942. Published by ALFRED A. KNOPF, New York. Price, $1.50.

This little book is the third in the series of children's books, "Wild World Tales," "factual stories of our native wild life told in a manner calculated to entertain while they instruct." It tells in simple language the life history of the Promethea moth, and is illustrated with 24 full-page photographs and many pen-and-ink sketches by the author. The account is clear and accurate, and the illustrations are unusually good.

This is the sort of book which we would recommend to entomologists who would like their children to become interested in insects. Our eight-year old son read it in one sitting, with evident enjoyment.—D. J. B.

MEMBERS OF THE ENTOMOLIGAL SOCIETY OF AMERICA ENROLLED IN THE ARMED AND RELATED SERVICE OF THE UNITED STATES[1]

ARCHER, SGT. A. F., Sanitary Technicians' School, Camp Grant, Ill.

BABERS, MAJ. FRANK H., Hdq. 39th C. A. Brig. A. A., Seattle, Wash.
BARNETT, SGT. HERBERT C., Division of Parasitology and Tropical Medicine, Army Medical School, Army Medical Center, Washington, D. C.
BARRETT, PVT. PAUL H., Med. Det., Percy Jones General Hospital, Battle Creek, Mich.
BARRETT, W. L., JR.
BELKIN, 1ST LT. JOHN N., Sn. C., M. D. R. P., M. R. T. C., Camp Joseph T. Robinson, Ark.
BENTON, CURTIS, Med. Corps.
BERTAGNOLLI, 2ND LT. ALFRED A., 877 Chemical Company, Barksdale Field, La.
BILLINGS, LT. S. C., Norfolk Army Base, H. R. P. E., Norfolk, Va.
BLANTON, LT. F. S., Sn. C., Fort Robinson, Ark.
BOHART, ENSIGN R. M., U. S. N. R., Malaria Control Lab., Hadnot Point, New River, N. C.
BROWN, CAPTAIN F. MARTIN, Colorado Springs, Colo.
BUNN, MAJ. RALPH W., 1st Medical General Laboratory, Fort Sam Houston, Tex.
BURKS, 1ST LT. B. D., Sn. C., Camp Van Donn, Centerville, Miss.
BUZICKY, 2ND LT. ALFRED.

CHAMBERLAIN, PVT. ROY W., Med. Det. S. C. U. 1968, Reception Center, U. S. Army, Fort Douglas, Utah.
CHRISTENSON, L. D., 3rd Malaria Survey Unit, New Orleans Staging Area, New Orleans, La.
CONNELL, 1ST LT. WM., Medical Section, 1580 S. U., Camp Campbell, Ky.
COPE, ENSIGN OLIVER B., Malaria Control, Marine Corps Air Station, Cherry Point, N. C.
CURTISS, LT. CHARLES.

DAGGY, ENSIGN RICHARD H., (M. C.) U. S. N. R., M Division, Navy 212, Fleet Post Office, San Francisco, Calif.
DAHM, PAUL A.
DANIEL, DERRILL M.
DELEON, PVT. DONALD, Co. B, 103 Bn., M. R. T. C., Camp Robinson, Little Rock, Ark.
DENNING, DONALD G., U. S. P. H. S. (R), 207 Civil Courts Bldg., New Orleans, La.
DODGE, H. RODNEY, U. S. P. H. S., Box 1095, Macon, Ga.
DORSEY, ENSIGN CARL K., U. S. N. R., Naval Medical School, Bethesda, Md.
DORST, MAJ. HOWARD E., Hq. M. R. T. C., Camp Robinson, Ark.
DOW, LT. RICHARD, Sn. C., Station Hospital, Camp Cooke, Calif.

EATON, PVT. CHARLES B., 615th T. S. S. (sp.), B. T. C. (5) A. F. F. T. T. C., Kearns, Utah.
ELISHEWITZ, HAROLD, Med. Res. Inst., National Naval Med. Cen., Bethesda, Md.
EMERSON, LT. K. C., Fort William McKinley, Rizal, P. I. (Reported missing. Probably prisoner of Japanese.)

FISHER, ELIZABETH, American Red Cross, Washington, D. C.
FISK, CAPT. FRANK W., Med. Sec., S. O. S., A. P. O. 886, care of Postmaster, New York, N. Y.

[1]A list of all entomologists, whether members of any entomological society or not, enrolled in the Armed and Related Services of the United States, will be published in an early issue of the Journal of Economic Entomology.

FREEBORN, LIEUT.-COL. S. B., Sr. Surgeon, Malaria Control in War Areas, 508 Volunteer Bldg., Atlanta, Ga.
FRONK, 2ND LT. W. DON, School Dept., Fitzsimmons Hospital, Denver, Colo.

GILLOGLY, PVT. LORIN R., Hdq. 80th Inf. Tng. Bn., Camp Roberts, Calif.
GRESSITT, J. LINSLEY, Prisoner of Japanese at Canton, China.
GURNEY, 1ST LT. ASHLEY B., Station Hospital, Camp Crowder, Mo.

HALL, DAVID G.
HARDEN, PHILIP, U. S. P. H. S. (R), 207 Civil Courts Bldg., New Orleans, La.
HART, LT. THOMAS A., Station Hospital, Camp Gordon, Georgia.
HARDY, CAPT. ELMO D., A. P. O. 629, c/o Postmaster, Miami Fla.
HAUG, LT. GORDON W., 1st Bn., Rocky Mountain Rangers, Colwood Camp, Victoria, B. C.
HEATON, 1ST LT. ROBERT R., M. D. R. P., Billings General Hospital, Fort Harrison, Ind.
HERMS, LT. COL. W. B., Army Medical Field Service School, Carlisle Barracks, Pa.
HITCHCOCK, PVT. F. C. JOHN D., 4th Platoon, 300th General Hospital, Camp Forrest, Tenn.
HOFFMAN, WM. E., Prisoner of Japanese at Canton, China.
HOLWAY, ENSIGN RICHARD T., U. S. N. R., Naval Medical Center, Bethesda, Md.
HORSFALL, 1ST LT. WM. R., Sn. C., Camp Grant, Ill.
HURLBUT, LT. HERBERT S., H-V (S), U. S. N. R., Box 36, N. O. B., Guantanamo, Cuba.
HUTCHINS, LT. (J. G.) ROSS E.

JONES, JR., CADET JOSEPH W., A. A. C., P. O. Box 173, Newbern, Tenn.

KECK, CAPT. C. B., A. U. S., Box 340, Honolulu, T. H.
KENT, ELLIS C.
KING, LT.-COL. W. V., Laboratory Fourth Service Command, Fort McPherson, Ga.
KLOTS, CAPT. ALEXANDER, B., Sn. C., Camp Robinson, Ark.
KNIGHT, ENSIGN KENNETH L., (M. C.), U. S. N. R., A. P. O. 932, care of Postmaster, San Francisco, Calif.
KNIGIN, TAMARATH, Malaria Laboratory, Office of Sector Surgeon, A. P. O. 868, care of Postmaster, New York, N. Y.
KRAFCHICK, PVT. BERNARD, General Hospital, Fort Dix, N. J.
KRAMER, CORP. SOL, M. D. P. S. S. S., Army Medical School, Washington, D. C.
KRETZSCHMAR, ENSIGN G., District Coast Guard Office, 310 N. Washington Square, Philadelphia, Pa.
KROMBEIN, LT. KARL V., 1318th Service Unit, Post Headquarters, Camp Pickett, Va.
KUITERT, LT. LOUIS C., Sn. C., Army Air Base, Dyersburg, Tenn.

LANHAM, PVT. URLESS N., 4th Mapping Squadron, March Field, Riverside, Calif.
LIVINGSTON, 1ST LT., E. M., Sn. C., Camp Pickett, Va.
LOWRIE, RAYMOND E.
LUND, LT. (J. G.) HORACE O., Naval Air Station, Elizabeth City, N. C.

MACCREARY, LT. (J. G.) DONALD, H-V (S), U. S. N. R., Newark, Del.
MANGRUM, PVT. JAMES F., 183 General Hospital, Fort Sill, Ok.la.
MANZELLI, 1ST LT. MANLIO, Sn. C., Station Hospital, Camp Carrabelle, Fla.
MARCH, 2ND LT. RALPH B., IV Ground Air Support Command, Presidio, San Francisco, Calif.
MASON, LT. COL. HORATIO C., Academic Dept., Infantry School, Ft. Benning, Ga.
MEDLER, ENSIGN, JOHN T., H-V (S), U. S. N. R., Yard Dispensary, Mare Island, Calif.
MILLIRON, 1ST LT. HERBERT E., Sn. C., 1560th Service Unit, Medical Section, Station Hospital, Camp Atterbury, Ind.
MUNDELL, R. C. (deceased 1942, while a member of fighting forces in India.)
MUNSON, SAM C.

NICHOLSON, H. PAGE, U. S. P. H. S. (R), 300 Essex Bldg., Norfolk, Va.
NYE, CAPT. W. P., U. S. Marine Corps, Camp Pendleton, Oceanside, Calif.

OMAN, LT. P. W., Sn. C., Carlisle Medical Center, Carlisle, Pa.
OWEN, CAPT. WM. B., Carlisle Barracks, Pa.

PARSONS, CORP. CARL T., Medical Detachment, Hendricks Field, Sebring, Fla.
PEDERSON, LT. (J. G.) CALVIN E., H-V (S), U. S. N. R., Malaria Control Laboratory, U. S. Naval Air Station, Trinidad, B. W. I.
PETERS, 1ST LT. HAROLD T., Station Hospital, Camp Pickett, Va.
PETERSON, ALLAN, U. S. P. H. S. (R), State Board of Health, Jackson, Miss.
PETTIT, LINCOLN C.
POST, R. L., Coast Guard, A. S. (R. R.), Bonneville, Ore.
PRATT, HARRY D., U. S. P. H. S., San Juan, Puerto Rico.
PRITCHARD, A. EARL, Base Hospital, A. P. O. 848, New York, N. Y.

REED, LT. W. D., Service Division, Edgewood Arsenal, Md.
RICHMOND, MAJ. E. A., Technical Division, C. W. S., Bldg. 330, Edgewood Arsenal, Md.
RIEGEL, 1ST LT. GARLAND T., Sn. C., Post Surgeon's Office, Ft. Leonard Wood, Mo.
RINGS, PVT. ROY W., Headquarters Reception Center, Ft. Benjamin Harrison, Ind.
ROBERTS, CAPT. R. A., Sn. C., Army Officers Tn. Bn., Carlisle Barracks, Pa.
ROCKSTEIN, CPL. MORRIS, Base Weather Office, Bradley Field, Conn.
ROSS, LT. E. S., Sn. C., 8th Service Command Laboratory, Ft. Sam Houston, Tex.
ROTH, LOUIS M., Laboratory, 4th Corps Area, Ft. McPherson, Ga.
RYAN, PVT. GEORGE S., Btry. C-399 CA, B. B. Bn., Sault Ste. Marie, Mich.

SCHROEDER, CAPT. PHILLIP C., R. O. T. C., University of Minnesota, Minneapolis, Minn.
SHIELDS, LT. S. E., Sn. C., Key West Barracks, Fla.
SMITH, GORDON E., A. P. O. 885, c/o Postmaster, Port of Embarkation, New York, N. Y.
SPENCER, MAJ. HERBERT, Sn. C., Station Hospital, Camp Shelby, Miss.
SPIETH, 1ST LT. HERMAN T., A. C. Roney Plaza, Miami Beach, Fla.
STAINS, ENSIGN GEORGE S., District Medical Office, 14th Naval District, Pearl Harbor, T. H.
STEARNS, MAJ. L. A., Sn. C., Hq. Ninth Air Force, Bolling Field, D. C.
STONE, 1ST LT. PHILIP C., Sn. C., Carlisle Barracks, Pa.
STRICKLAND, E. H., No. 133, Can. Army Basic Tn. Cen., Prince of Wales Armory, Edmonton, Alberta, Can.

TARSHIS, IRVIN.
THATCHER, CAPT. T. O. (0-305-165), Hq. 495 C. A. & Br. (A. A.), A. P. O. 860, care of Postmaster, New York, N. Y.
TRAUB, 1ST LT. ROBERT, Sn. C., 9th Malaria Survey Unit, New Orleans Staging Area, New Orleans, La.
TUCK, PVT. J. B., O. C. P. S., Det. M. R. T. C., Company B, Camp Barkeley, Tex.
TULLOCH, GEO. S.

WALLACE, CORP. GEO. E., Co. K, ER 8, Enlisted Students Bn., Student Rgt. T. D. School, Camp Hood, Tex.
WENZEL, 1ST LT. R. L., Sn. C., 707th Med. Sn. Co., Ft. George G. Mead, Md.
WEST, 2ND LT. WM. R., 14th R. O. C., M. C. S., Co. B, Barracks B, Quantico, Va.
WILSON, LT. JOHN W., M. C., Wellston Air Depot, Macon, Ga.
WOKE, LT. PAUL A., U. S. N. R., Navy 213, care of F. P. O., New York, N. Y.
WORTHLEY, MAJ. H. N., C. W. S., R. T. C., Camp Sibert, Ala.

THE ENTOMOLOGICAL SOCIETY OF AMERICA

REPORT OF THE THIRTY-SEVENTH ANNUAL MEETING

New York, New York, December 29-31, 1942

The Thirty-seventh Annual Meeting of the Entomological Society of America was cancelled on December 7, 1942, with the approval of the Executive Committee and at the request of the Office of Defense Transportation, United States Government. Arrangements for the meeting were practically completed and the program was in press at the time of cancellation. This is the first time since its organization that the Society has not held its Annual Meeting.

The program which had been arranged for the three-day meeting at the Hotel New Yorker follows:

Opening Session, Tuesday Morning, December 29

1. A Revision of the Nearctic Gnats of the Tribe Tendipedini (=Chironomini). (15 min.) H. K. TOWNES, Bureau of Entomology and Plant Quarantine, Washington, D. C.
2. The Internal Genitalia and Mating Behavior of *Eurukuttarus confederata* Grote. (8 min., Lantern.) JOSEPH L. WILLIAMS, Lincoln University, Pennsylvania.
3. The Male Reproductive System of the Carpenter Ant, *Camponotus herculeanus pennsylvanicus* De Geer (Formicidae: Hymenoptera). (15 min., Lantern). JAMES FORBES, Fordham University, New York, N. Y.
4. Some Vitamin Requirements of Black Carpet Beetles, *Attagenus* sps. (5 min.) WARREN MOORE, Bon Air, Virginia.
5. Intrapuparial Phases of *Rhagoletis pomonella* Walsh. (10 min., Lantern). R. W. DEAN, New York State Agricultural Experiment Station, Poughkeepsie, New York.
6. The Ecology, Seasonal History, and Relative Prevalence of Mosquitoes of the Great Swamp in Rhode Island during 1942. (10 min., Lantern, 3¼x4; 2x2.) HERBERT KNUTSON, Rhode Island State College, Kingston, Rhode Island.

11:55 A. M.—Adjourn to Grand Ball Room, Hotel New Yorker, to meet with the American Association of Economic Entomologists to hear the address of their president.

Second Session, Tuesday Afternoon, December 29

JOINT SESSION WITH AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

SYMPOSIUM

"Entomology and the War"

Entomological Problems Imposed by War Conditions. (25 min.) P. N. ANNAND, Bureau of Entomology and Plant Quarantine, Washington, D. C.

Entomology and Malaria Control in War Areas. (13 min.) L. L. WILLIAMS, JR., U. S. Public Health Service, Atlanta, Georgia.

Some Entomological Aspects of Troop Mobilization. (13 min.) LIEUTENANT-COLONEL W. V. KING, Sn. C., Atlanta, Georgia.

Entomology and Food Mobilization. (25 min.) W. P. FLINT, Illinois Natural History Survey, Urbana, Illinois.

Agricultural Insecticides in Relation to Critical War Materials. (25 min.) R. C. ROARK, Bureau of Entomology and Plant Quarantine, Washington, D. C.

Taxonomy and the War. (25 min.) C. F. W. MUESEBECK, Bureau of Entomology and Plant Quarantine, Washington, D. C.

Training Entomologists for Service in the Armed Forces. (25 min.) C. L. METCALF, University of Illinois, Urbana, Illinois.

Third Session, Tuesday Evening, December 29

ANNUAL PUBLIC ADDRESS

"The Earliest Insects." DR. F. M. CARPENTER, Harvard University, Cambridge, Massachusetts.

Fourth Session, Wednesday Morning, December 30

7. The Entomological Applications of Fluorescence Microscopy. (10 min., Lantern, 2x2.) ROBERT L. METCALF and ROBERT L. PATTON, Cornell University, Ithaca, New York.
8. A New Relationship of the Bursa Copulatrix to the Female Reproductive System in Lepidoptera. (5 min., Lantern.) JOSEPH L. WILLIAMS, Lincoln University, Pennsylvania.
9. A Catalogue and Reclassification of the Nearctic Ichneumonidae. (20 min.) H. K. TOWNES, Bureau of Entomology and Plant Quarantine, Washington, D. C.
10. Effect of Potassium Fluoride and Pyrethrum on *Periplaneta americana* L. with Chinese Ink Blocked Hemocytes or Trypan Blue Stained Nephrocytes. (15 min.) E. R. MCGOVRAN, J. FRANKLIN YEAGER, E. L. MAYER and SAM C. MUNSON, Bureau of Entomology and Plant Quarantine, Beltsville, Maryland.
11. Excavation and Closure of the Nest by "Ammophila" and some other Digger Wasps, with a Demonstration of "Slow-motion" Pictures, Illustrating the Wasps' Behavior. (15 min., 16 mm. Motion Pictures.) C. T. BRUES, Harvard University, Cambridge, Massachusetts. Pictures by MRS. C. T. BRUES.
12. Selection of Colored Lights by Night-flying Insects. (15 min., Lantern.) LORUS J. MILNE AND MARGERY J. MILNE, Randolph-Macon Woman's College, Lynchburg, Virginia, and Johnson Foundation, University of Pennsylvania, Philadelphia, Pennsylvania.
13. Shelter Tree Insects. (12 min.) E. P. FELT, Bartlett Tree Research Laboratories, Stamford Connecticut.
14. The Action of Bean Leaves Against the Bedbug, *Cimex lectularius* L. (10 min., Lantern.) H. H. RICHARDSON, Bureau of Entomology and Plant Quarantine, Washington, D. C.

Fifth Session, Wednesday Afternoon, December 30

TAXONOMISTS' CONFERENCE

Presiding: C. F. W. MUESEBECK, Bureau of Entomology and Plant Quarantine, Washington, D. C.

Subject: The Species Problem.

Sixth Session, Thursday Morning, December 31

15. The Biology and Ecology of the Inhabitants of the Nests of the Prairie Meadow Mouse, *Microtus ochrogaster* (Wagner). (15 min., Lantern.) PHILIP C. STONE, University of Missouri, Columbia, Missouri.
16. Some South American Water Bugs. (10 min., Lantern.) H. B. HUNGERFORD, University of Kansas, Lawrence, Kansas.
17. Lipid Nerve Sheaths in Insects and Their Probable Relations to Insecticide Penetration. (15 min., Lantern.) A. GLENN RICHARDS, JR., University of Pennsylvania, Philadelphia, Pennsylvania.
18. The Role of Nutrition in Sex Determination in the Hymenoptera. (15 min.) STANLEY E. FLANDERS, Citrus Experiment Station, Riverside, California.
19. Histology of the Mouthparts of Larval Ticks (Ixodoidea). (10 min., Lantern, 3¼x4; 2x2.) HAROLD ELISHEWITZ, University of Minnesota, Minneapolis, Minnesota.

20. Histology of the Metamorphosis of the Mouthparts of Larval Ticks (Ixodoidea). (10 min., Lantern, 3¼x4; 2x2.) HAROLD ELISHEWITZ, University of Minnesota, Minneapolis, Minnesota.
21. A Descriptive Study of the Pilotaxy of a Modal *Culex pipiens* Fourth Stage Larva. (By Title.) THOMAS A. HART and J. H. HART, Station Hospital, Camp Gordon, Georgia.
22. Parallel Geographical Variation in Numerous Megachilid Bees. (10 min., Lantern.) CHARLES D. MICHENER, American Museum of Natural History, New York, N. Y.
23. Qualitative Versus Quantitative Analysis in Systematics. (15 min.) MONT A. CAZIER, American Museum of Natural History, New York, N. Y.

The New York Meeting having been cancelled it was impossible to hold the Annual Business Meeting, but the Executive Committee has transacted all urgent business by mail. The reports of the Officers and Committees for 1942 which would have been submitted at the New York Meeting, and the business transacted by the Executive Committee up to February 1, 1943, follows:

REPORT OF THE SECRETARY

During the year 1942, the following having been duly nominated and recommended, were elected members of the Society by mail ballot of the Executive Committee:

THEODORE ALLEN, 2520 Mulberry Ave., Muscatine, Iowa.
THOMAS GLENN BOWERY, 214 Birmingham Ave., Avalon, Pa.
WILLIAM RICHARD COBB, 1624 Rincon Drive, Whittier, Calif.
WILLIAM EDGAR CURTIS, Dept. Biology, Cornell University, Ithaca, N. Y.
ERVIN FREDERICK DAILEY, 7818 Bothell Way, Seattle, Wash.
THOMAS A. HART, West Georgia College, Genola, Ga.
CARL GEORGE KADNER, Loyola University, Los Angeles, Calif.
BERNARD KRAFCHICK, 234 Linden Ave., Ithaca, N. Y.
JOHN LANE, Instituto de Higiene de São Paulo, Caixa Postal 2.920, São Paulo, Brazil.
E. MORTON MILLER, Dept. Zoology, University of Miami, Coral Gables, Fla.
MAYNARD JACK RAMSAY, Dept. Entomology, Cornell University, Ithaca, N. Y.
FREDERICK JOHN SIMONDS, Imperial Parasite Service, Belleville, Ontario, Canada.
RUSSELL WM. STRANDTMANN, East Texas State Teachers College, Commerce, Texas.
VICENTE VELASCO CARRERA, 9a—no. 4-68, Cali, Colombia.
MINTER JACKSON WESTFALL, JR., Department Entomology, Cornell University, Ithaca, N. Y.

With the approval of the Executive Committee a joint symposium on the subject "Entomology and the War" was arranged with the American Association of Economic Entomologists.

With the approval of the Executive Committee a share of the expenses of PROFESSOR E. O. ESSIG, from Berkeley, California, to Washington, D. C., was paid. PROFESSOR ESSIG is the Society's representative on the Committee for Biology and Agriculture of the National Research Council.

DR. H. T. SPIETH and DR. A. B. KLOTS were appointed by PRESIDENT ALEXANDER to serve on the joint Local Committee for the arrangements of the New York meeting.

With the approval of the Executive Committee DR. F. M. CARPENTER, Harvard University, was invited to give the Annual Public Address at the New York Meeting.

DR. S. A. GRAHAM was appointed by PRESIDENT ALEXANDER as the Society's representative on a joint committee with the American Association of Economic Entomologists for the coordination of entomology with the war effort.

With the approval of the Executive Committee the expenses of DR. S. A. GRAHAM were paid from Ann Arbor, Michigan, to Baltimore, Maryland, to attend a meeting of the Committee for Coordination of Entomology with the War Effort.

The Executive Committee approved the transfer of $1,000.00 from the Permanent Fund to the Current Funds to provide for publishing the Annals with the proviso that $250.00 be returned from the Current Fund to the Permanent Fund on December 1, 1942, and that $250.00 be returned from the Current Fund to the Permanent Fund on December 1, 1943, December 1, 1944, and December 1, 1945. Due to a gift from an anonymous donor and to contributions by institutions and individuals towards the publication of papers in the Annals it was found not necessary to make this transfer of funds and it now appears likely that no such transfer will be found necessary in 1943.

PRESIDENT ALEXANDER appointed the following as a committee to investigate and report to the Society on the costs of publishing the Annals: DR. CLARENCE H. KENNEDY, Chairman; DR. T. H. FRISON and MR. J. R. DE LA TORRE-BUENO.

PRESIDENT ALEXANDER appointed DR. T. H. FRISON to the Thomas Say Foundation Committee to fill out the term of GEORGE P. ENGELHARDT, deceased.

PRESIDENT ALEXANDER appointed the following nominating committee for 1942: DR. H. B. HUNGERFORD, Chairman; DR. WILLIAM A. RILEY and DR. C. T. BRUES.

PRESIDENT ALEXANDER appointed DR. A. L. MELANDER to represent the Society at the inauguration of HARRY NOBLE WRIGHT as the President of the College of the City of New York.

At the request of the Office of Defense Transportation, United States Government, and with the approval of the Executive Committee, the Thirty-Seventh Annual Meeting scheduled for New York, N. Y., December 29–31, 1942, was cancelled.

The Executive Committee has conducted the following business of the Society by mail due to the cancellation of the 1942 Annual Meeting:

The following have been elected to membership in the Society:

EDWARD LAURENCE ATKINS, JR., 708 So. Mathews Ave., Urbana, Ill.
JOHN N. BELKIN, T.V.A. Health and Safety Dept., Wilson Dam, Ala.
JOHN HUGH BROWN, University of Alberta, Edmonton, Alberta, Canada.
HERBERT T. DALMAT, Department of Entomology, Cornell University, Ithaca, N. Y.
JOHN A. FLUNO, 828 W. High St., Jefferson City, Mo.
JAMES T. GRIFFITHS, Department of Entomology, Alabama Polytechnic Institute, Auburn, Ala.
JOHN M. HUTZEL, 21 E. Woodruff Ave., Columbus, Ohio.
RICHARD READE, British Military Hospital, Kingston, Jamaica, B. W. I.
GEORGE S. RYAN, Angola, Indiana.
RAY FRED SMITH, 112 Agri. Hall, University of California, Berkeley, Calif.
THOMAS COBB WATKINS, Comstock Hall, Cornell University, Ithaca, N. Y.
STEPHAN LANE WOOD, Department of Entomology, Utah Agricultural College, Logan, Utah.

The following have resigned during the year: RAIMON L. BEARD, ALFRED A. BERTAGNOLLI, M. H. BRUNSON, HARRY R. BRYSON, DERRILL M. DANIEL, M. H. DONER, CHARLES B. EATON, ROBERT K. FLETCHER, DAVID E. FOX, ORVILLE B. HITCHCOCK, MRS. R. E. HUTCHINS, R. E. HUTCHINS, DONALD L. JACKMAN, ADOLPH KLEIN, URLESS N. LANHAM, DONALD MACCREARY, REV. H. E. MATTINGLY, JAMES A. MULLEN, SAM C. MUNSON, DONALD E. PARKER, L. F. PINKUS, G. H. PLUMB, K. A. SALMON, E. W. E. SCHEAR, L. R. SETTY, ALBERT R. SHADLE, FRED SKOOG, LOUIS A. STEARNS, GEORGE S. TULLOCH, OTTO E. WENGER and DON B. WHELAN.

The following have been automatically dropped from membership either because of failure for three or more years to pay dues or because they cannot be reached: LEONARD L. HANSEN, J. W. MONK, and MAURICE E. PHILLIPS.

The Society has suffered the loss by death of the following four members during the past year: GEORGE P. ENGELHARDT, CARLOS C. HOFFMANN, ELIZABETH M. MOFFATT, and R. C. MUNDELL.

GEORGE P. ENGELHARDT, a Charter Member of our Society and a Fellow since 1932, was born in Hanover, Germany, on November 23, 1871, and died at Scarsdale, New York, on May 24, 1942. His general activities in biology were many and fruitful. For twelve years he was assistant curator of the Children's Museum in Brooklyn, New York; during eighteen years he was curator of invertebrates in the Brooklyn Museum proper, retiring in 1930 as honorary curator of the department of natural science in that institution. In search of his favorite Aegeriidae and in collecting trips for the Museum he traveled all over North America from Newfoundland and Labrador into Central America as far as Guatemala, and to the Bahama Islands. In these expeditions he invariably remembered his friends and brought them choice specimens from distant and inaccessible places. He was a Fellow of the American Association for the Advancement of Science, a member of the New York Entomological Society and the Brooklyn Entomological Society. He was Treasurer of the latter Society for many years and a most helpful and valuable member of its Publication Committee. His passing is a sad blow to American Entomology, of which he was a most enthusiastic supporter and advocate. In him we have lost also the world authority on the Aegeriidae. It is gratifying to know that his great monograph on this interesting group, which was completed at the time of his death, is to be published before long. He was one of those sterling Americans who by their sincere work honor the land of their birth and add scientific luster to our Republic. He was always an American of enduring loyalty to the land of his free adoption. Yet, current European events caused him great grief. GEORGE P. ENGELHARDT was typical of the best kind of American citizens of German origin. To all of us, his death is the personal loss of a cherished friend, patient with our human foibles and wise in counsel.—J. R. DE LA TORRE-BUENO.

CARLOS C. HOFFMANN, a member of our Society since 1939, was born in Frankfort, Germany, in 1876, and died in the city of Mexico, November 26, 1942, after a long illness. He arrived in Mexico in 1901 and worked for nineteen years in the Public Health Department as head of the Parasitical Division of the Hygiene Institute, where collaborating with the National University of Mexico, he took part in expeditions to various regions in the Republic in order to study "onchocercosis," and determined the malarial zones of the country as well as the principal transmitters of malaria. He studied the Simuliidae of the onchocercosis region of Chiapas. He organized and took part in campaigns against the locust, malaria and yellow fever. In 1929 he was one of a group of founders of the Biological Institute of the National University, where he worked as head of the Zoological Department and the Section of Entomology. He was professor of Zoology, first in the national Preparatory School, and afterwards in the Science Department of the same University. He was particularly interested in the study of the Arachnida, Diptera and Lepidoptera of Mexico, publishing more than one hundred bulletins about them. In the last three years he limited his field of study and work to the Lepidoptera of Mexico almost exclusively. This resulted in the publication of a Systematic and Zoographical Catalogue from material and observations compiled in the course of the forty years of study of the Mexican Lepidopteran fauna. The Catalogue comprises a critical list of species and forms of the country, bibliographical dates of the original descriptions, synonymy and notes on geographical distribution. He did not live to finish the catalogue as he had planned. Only three parts were published in the Annals of the Biological Institute of the National University of Mexico, the Papilionoidea in the first, Hesperioidea in the second and Sphingoidea and Saturnoidea in the third, with a total of 1,542 species. He had all the material ready for a fourth part at the time of his death. He was the first in Mexico to study the formation of races in the "Anopheles Mexicanos." He took part as a representative of the University of Mexico, in expeditions for the study of the poorer regions of the country. This resulted later in improving the living conditions of the inhabitants. He wrote two monographs for the Medical Entomological Society of Mexico with the idea of forming memoirs that could be used by the Mexican physician, hygienist, biologist, or veterinarian. These monographs were: "The Ticks of Mexico" and "The Scorpions of Mexico." The first could not be completely published due to causes beyond his control. Only some few parts were published in the Annals of the Institute of Biology. The second monograph was published in the same Annals from 1931 to 1939. He was a member of several Scientific Societies, both

Mexican and foreign. He was an outstanding teacher and an indefatigible worker whom death surprised at his post, among his books and collections. Under his direction we had the privilege to study and work in the Section of Entomology.—(Miss) Leonila Vasquez.

Elizabeth M. Moffatt, a Life Member of our Society, died in Los Angeles, California, in 1938.

R. C. Mundell, a member of our Society since 1930, died in India in 1941 or early 1942. He served for a number of years as an entomologist with the Commonwealth Prickly Pear Board of Australia. Later he was a member of the Division of Economic Entomology of the Council for Scientific and Industrial Research of the Commonwealth of Australia, and had been stationed in India for several years. At the time of his death he was a member of the fighting forces in India.

The total membership on December 31, 1942, is 939.

Article V, Section 3, of the Constitution (Annals, Vol. XXIII, p. vi, 1930) provides: "All officers shall be elected by ballot at the Annual Meeting for the term of one year and shall be eligible for re-election." The Executive Committee interprets this to mean that officers cannot be elected by any other procedure and have voted to continue the present officers during the year 1943, since no Annual Meeting was held in December, 1942.

The following were elected by the Executive Committee to the Editorial Board of the Annals for the term expiring December 31, 1945: William Procter, E. M. Walker and F. M. Carpenter.

The following were elected by the Executive Committee to the Thomas Say Foundation Committee for the two-year term ending December 31, 1944: T. H. Frison and C. F. W. Muesebeck.

The Executive Committee voted to contribute $100.00 to the Royal Zoological Society of London for the support of the Zoological Record.

Respectfully submitted,

Clarence E. Mickel, *Secretary.*

REPORT OF THE TREASURER

Current Funds

RECEIPTS

Balance on hand in Bank, December 10, 1941 (See Annals, Vol. 35, p. 129)	$1,110.00
From Annual Dues of Members to December 21, 1942	3,414.11
From Clarence H. Kennedy, Managing Editor of Annals	1,500.00
From three Life Memberships—Nellie M. Payne, Leonard D. Tuthill and Elwood C. Zimmerman	150.00
From sale of one Membership List	1.00
Total	$6,175.11

EXPENDITURES

Postage, including 2,000 three-cent stamped envelopes, and 1,400 one and one-half cent stamps	$ 91.52
Spahr and Glenn Printing Co., Columbus, Ohio; printing December, 1941, and March, June and September, 1942, Annals	2,990.60
Letterheads for President and Secretary-Treasurer, and stamped envelopes for President	17.00
Office Supplies	4.40
Printing Preliminary Announcements, Envelopes and Programs	80.00
Clerical Services	50.40
Contribution to Royal Zoological Society of London for Zoological Record	100.80
Travel expenses, Secretary-Treasurer to San Francisco Meeting, and to Urbana, Illinois, for conference with A. A. E. E. Program Committee; E. O. Essig to Washington, D. C., for meeting of National Research Council, Section Biology and Agriculture (in part); S. A. Graham	

to Baltimore, Md., for meeting of joint committee on Entomology and the War	233.89
Exchange on checks at Bank	26.25
Telegrams	5.32
Transfer Life Membership Payments to Permanent Fund of NELLIE M. PAYNE, LEONARD D. TUTHILL and ELWOOD C. ZIMMERMAN	150.00
Total	$3,750.18
Balance in Checking Account, December 21, 1942	2,424.93
Total	$6,175.11

LIABILITIES

The Society owes the Publishers for the December, 1942, Annals. Of the above cash receipts for dues, $1,384.25 is for 1943 and other dues paid in advance.

PERMANENT FUND

RECEIPTS

Balance in Savings Account, December 10, 1941	$3,776.50
Interest on Savings Account, December 10, 1941, to December 21, 1942	37.40
Interest on Liberty Bond 45554-D	1.44
From three Life Memberships	150.00
Total	$3,965.34

EXPENDITURES

(None)

Balance in Savings Account, December 21, 1942	$3,965.34
One Liberty Bond 45554-D	50.00
Balance in Permanent Fund	$4,015.34

RESOURCES

Liberty Bond, 45554-D	$ 50.00
Balance in Savings Account	3,965.34
Balance in Checking Account	2,424.93
Total	$6,440.27

Respectfully submitted,

CLARENCE E. MICKEL, *Treasurer.*

REPORT OF THE MANAGING EDITOR OF THE ANNALS

The Annals for 1942 will be a volume of 484 pages as against 868 for 1941. The large volume for 1941 made an overdraft on 1942 income in an attempt to clear the great amount of manuscript on hand. The small volume for 1942 has been kept exactly within the amount set aside for the Annals by SECRETARY-TREASURER MICKEL for 1942.

The Annals has been aided by a gift of $500.00 from an anonymous friend who admires its good looks, and by a series of articles the printing costs of which have been paid for by the author or the author's institution. These are the University of Utah for R. V. Chamberlin and W. Ivie, $100.00; Richard Dow, $37.00; Thomas A. Hart (two articles), $77.50; and the Gorgas Memorial Institute, for five Fairchild articles, $214.50; a total of $584.00. This amount is for printing and does not include cost of cuts also paid for by the authors. At little cost (postage, etc.) to the Society these articles added about 120 pages to the 1942 volume.

With the war and loss of foreign subscriptions, the latter have dropped from 240 to 196, an income loss of $242.00. With some emphasis on descriptions of new species of Central and South American insects to make our Annals of use

to South American institutions we should in the next few years be able to add a substantial number of South American institutions to our list. Otherwise the Annals is of little interest to South American entomologists. At present we have only eight such subscribers. Brazil alone has 70 journals which publish biological articles. With the present efforts at good will towards the southern countries the Society could help in this manner and would help itself in building income, permanent from year to year, except for war. In periods of hard times the subscription list is the backbone of Society income as it varies little from such causes. Memberships come and go, but the usual institutional subscription is permanent until mails close against it on account of war.

The Society can be very grateful to the authors of recent articles for the high quality of the same. Articles that in years past would have been sent past the Annals to recognized zoological journals are now coming to the Annals in number up to the capacity of the Annals to use them. Every effort has been made in editing to give articles pleasing illustrations and an attractive format. The Annals is then rewarded with high grade material which in turn brings in more high grade material.

The Managing Editor has succeeded in having the Ohio State University give PROFESSOR DONALD J. BORROR one-third of his teaching schedule time for work on the Annals. PROFESSOR BORROR is a meticulous proof-reader and has helped in pinches before. The time of BORROR as Assistant Managing Editor amounts to an annual gift from the Ohio State University to the Annals of approximately $900.00.

The financial summary follows:

RECEIPTS

Non-member subscriptions	$ 880.58
Back numbers and reprints	357.38
From authors for cuts and printing	522.02
Gift to the Annals	500.00
Undeposited checks from 1941	18.00
Bank balance December 20, 1941	46.17
Total	$2,324.15

EXPENDITURES

To engravers	$ 446.59
Office help	240.00
Postage	63.60
Miscellaneous	28.33
Undeposited checks	5.37
Bank balance December 18, 1942	40.26
To Secretary-Treasurer	1,500.00
Total	$2,324.15

Respectfully submitted,

CLARENCE H. KENNEDY, *Managing Editor.*

REPORT OF THE TREASURER OF THE THOMAS SAY FOUNDATION

RECEIPTS

Balance on hand, December 23, 1941	$327.29
From 1941 sales, not previously reported	9.70
1942 sales of Volume I—1 at $3.00	3.00
1942 sales of Volume II—2 at $4.50	9.00
1942 sales of Volume II—1 at $5.00	5.00
1942 sales of Volume III—2 at $3.60	7.20
1942 sales of Volume III—2 at $4.00	8.00
Interest to June 30, 1942	4.98
Total	$374.17

EXPENDITURES

Postage	$ 1.51
Total	$ 1.51
Balance in Purdue State Bank, January 18, 1943	$372.66

The manuscript for Volume IV, "The Blowflies of North America," has been submitted by the author, DR. DAVID G. HALL, and your committee hopes to secure publication the coming year.

Respectfully submitted,

J. J. DAVIS, *Editor and Treasurer.*

REPORT OF THE AUDITING COMMITTEE

We, the undersigned members of the Auditing Committee, beg to report that we have carefully examined the accounts of the Treasurer of the Society, the Managing Editor of the Annals and the Treasurer of the Thomas Say Foundation for the year 1942, and have found them to be correct and properly balanced.

Respectfully submitted,

JOSEF N. KNULL,
B. ELWOOD MONTGOMERY,
JOHN H. HUGHES, *Chairman.*

REPORT OF THE REPRESENTATIVE TO THE COMMITTEE ON BIOLOGY AND AGRICULTURE OF THE NATIONAL RESEARCH COUNCIL

The meeting of the Division of Biology and Agriculture of the National Research Council convened at the Academy of Natural Sciences, Washington, D. C., on Saturday, April 11, 1942. The agenda consisted of the following:

The minutes of the Annual Meeting of April 12, 1941.
Expansion of Activities of the Division in Latin America.
Reports of Committees.

MATTERS OF ENTOMOLOGICAL INTEREST (proposed by entomological representatives.)

1. The need for a united national *all-out war program* for entomologists in the United States.

   Attention was called to the careful preparations in England and the almost complete use made of the entomologist in the programs involving

   (1) Agricultural Entomology. Production of crops.
   (2) Stored food and clothing, protection and conservation.
   (3) Medical and Veterinary Entomology.

2. The need of a definite emergency program among the educational and research institutions of this country towards

   (1) Aid to the government in respect to food production and conservation.
   (2) Maintaining a high level in the instruction and training of entomologists for the war effort.
   (3) Maintaining necessary numbers of the best trained entomologists in all needed fields served by the entomologists as
      (a) Medical and sanitary entomology.
      (b) Crop production.
      (c) Food conservation and protection.
      (d) Animal protection.
      (e) Protection of wool, leather, fabrics, wood, etc.
      (f) Protection of rubber-producing plants.

3. Recommendations of the Entomologists[1] to the "General Committee of the National Research Council" for immediate action.

(In view of no committees or reports from entomologists.)

(1) The deferment of entomologists engaged in teaching, research, or practical work necessary to the war effort.

(2) Provisions for the continuation of teaching and training men in entomology for the duration of the war and for the reconstruction period following the war.

(3) Provisions for protection against insects in relation to

(a) Human life in camps.

(1) Such disease-bearing insects as fleas, lice, mosquitoes, flies, etc.

(2) Tormenting insects, as flies, bedbugs, cockroaches, gnats, etc.

(b) Growing crops.

(c) Stored food products.

(d) Clothing fibers, wool, wood, etc.

4. The need for a Committee on Plant Protection within the National Research Committee. This matter was fully discussed and a committee authorized to consist of Entomologists and Plant Pathologists, as follows:

Entomologists:

J. L. HORSFALL, American Cyanamid Co., New York, N. Y.
T. H. FRISON, Illinois Natural History Survey, Urbana, Ill.
A. S. HOYT, Bureau of Entomology and Plant Quarantine, U.S.D.A., Washington, D. C.
DWIGHT ISELY, University of Arkansas, Fayetteville, Ark.
C. E. PALM, Cornell University, Ithaca, N. Y.
E. O. ESSIG, University of California, Berkeley, Calif.

Plant Pathologists:

E. C. STAKMAN, University of Minnesota, Minneapolis, Minn.
R. J. HASKELL, U. S. Department of Agriculture, Washington, D. C.
M. W. GARDNER, University of California, Berkeley, Calif.
J. E. MELHUS, Iowa State College, Ames, Iowa.
G. M. ARMSTRONG, Clemson College, Clemson, S. C.
J. G. LEACH, West Virginia University, Morgantown, W. Va.

This committee was authorized to hold meetings and conduct its work as deemed advisable. It was instructed to work with and to report to the General Committee.

However, since no chairman was appointed, the committee has been unable to function.

On November 19, 1942, in response to a report I made to DR. GRIGGS, Chairman of the Division of Biology and Agriculture, a letter was received from the latter announcing a Committee on Crop Protection composed of a personnel quite different from that named on the Committee on Plant Protection already provided for. Whether this new committee replaces the former one or not is at present unknown to the writer.

Respectfully submitted,

E. O. ESSIG, *Representative.*

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[1]By E. O. ESSIG, Representative of the Entomological Society of America, and C. E. PALM, Representative of the American Association of Economic Entomologists.

REPORT OF THE JOINT COMMITTEE ON COORDINATION OF ENTOMOLOGY WITH THE WAR EFFORT

The two entomological organizations at their meetings in San Francisco December, 1941, adopted a special joint resolution (Annals Ent. Soc. Amer., Vol. XXXV, p. 133; Jour. Econ. Ent., Vol. XXXV, p. 132) as evidence of a patriotic determination of the members to direct the professional efforts of entomologists into lines of maximum usefulness to the government and people of the nation in a period of unprecedented crisis. The resolution expressed the consciousness of members of the entomological profession of an unquestioned need for constructive leadership and for unified effort, and to attain these essential ends, the resolution specified certain steps which it seemed desirable to take at the earliest practicable moment.

Acting on the recommendations made to him in this resolution, the Chief of the Bureau of Entomology and Plant Quarantine on January 31, 1942, communicated with various leaders in entomology relative to the holding of a special conference to institute and work toward the indicated objectives. The replies received apparently did not indicate that a fairly representative attendance might be expected, inasmuch as he (March 5) asked the president of the two entomological organizations to designate a committee to confer with him. Acting on this suggestion PRESIDENT WEISS of the American Association of Economic Entomologists and PRESIDENT ALEXANDER of the Entomological Society of America named MESSRS. F. L. CAMPBELL and C. H. RICHARDSON.

MESSRS. CAMPBELL and RICHARDSON conferred with the Chief of the Bureau of Entomology and Plant Quarantine and with others, and indicated one line of action as immediately important. They recommended the appointment of a Joint Committee of the American Association of Economic Entomologists and the Entomological Society of America to act in a liaison capacity between civilian entomologists and the military services. They suggested a plan of acquiring information on entomological personnel and other matters which would help to bring about further professional utilization of entomologists in the military services. The committee appointed by the two societies consists of MESSRS. ERNEST N. CORY, ROBERT MATHESON and F. C. BISHOPP, Chairman.

At the San Francisco meeting, the American Association of Economic Entomologists authorized the appointment of a committee to work with manufacturers of insecticides and with governmental agencies concerned with priorities of such materials, and to keep entomologists informed regarding changes in the availability of insecticidal materials. This committee was formed by the appointment of MESSRS. C. C. HAMILTON, R. C. ROARK and J. L. HORSFALL, Chairman, designated as the Committee on Insecticide Supplies. The committee is functioning, and is also co-operating with a similar committee concerned with fungicides. These two committees are unrelated to the Committee on Coordination of Entomology with the War Effort, and the appointment of these committees will indicate why the Committee later established does not deal with these subjects.

In the opinion of PRESIDENT WEISS and others, the tasks of these two special committees failed to include the entire emergency effort contemplated in the joint resolution. On April 20, 1942, he appointed a Committee on Coordination of Entomology with the War Effort, consisting of MESSRS. JOHN S. HOUSER, L. M. PEAIRS, P. D. SANDERS, FRANK N. WALLACE and E. F. PHILLIPS, chairman. On recommendation of the Committee, PRESIDENT WEISS invited the Chief of the Bureau of Entomology and Plant Quarantine to nominate a member of the administrative staff of the Bureau to take membership on the Committee, and AVERY S. HOYT was so nominated and appointed. The Committee also recommended that the Secretary of the Association, ERNEST N. CORY, be named on the Committee, and this was done. Subsequently the Entomological Society of America designated S. A. GRAHAM as a representative of that organization on the Committee. The present Committee then consists of the eight persons named, of whom five are members of both organizations.

The originally appointed Committee met in College Park, Maryland, May 8 to 10. It reported to the Executive Committee, and this report was published in the belated April issue of the Journal of Economic Entomology, advising that

coordinators be indicated for the control of the more important insect pests, to carry control recommendations to the grass roots as soon as possible.

After approval of the plan recommended by the Committee, and by arrangement of the entire Committee, MESSRS. CORY, SANDERS, HOYT and PHILLIPS met in Washington, June 10 to 12. Aided by heads of various divisions of the Bureau of Entomology and Plant Quarantine, a survey was made of the most important insect pests of those agricultural crops for which increased quotas had been established by the Secretary of Agriculture, and for each such insect pest or group of pests, a member of the Association was selected as a leader to head an attack on the problem of furnishing information on methods of control as quickly as possible to those on the firing line of production. To conduct these tasks, the Committee selected entomologists without regard to administrative affiliations, making the selections on the basis of qualifications and skill in conducting such undertakings. The Committee was well aware that it possesses no authority to make such assignments, but it was equally aware that entomologists are ready and willing to take on any extra task, if it gives promise of aiding the war effort.

There are still other problems for which an active emergency campaign would be helpful, and the Committee advised entomologists to set up their own plans for any of these. In at least one instance this is being done. In a few instances only did the Committee go beyond problems which pertain to increased crop quotas set by the Secretary of Agriculture. In cases in which the Committee knew that additional action was already under way it did not offer suggestions. The responses of entomologists have been in the affirmative, enthusiastic and heart-warming, and all the more satisfying at a time when members of the profession are called upon to carry an increased share of responsibility as citizens.

It would be futile to undertake an evaluation of an effort of this type. All that the Committee tried to do was to point out opportunities for service, leaving it to the leaders to select their own aids, to discover the most effective avenues through which to transmit the needed information and recommendations. Doubtless opportunities have been overlooked, and perhaps some of the efforts may prove ineffective, but the Committee did its best to indicate important problems and to allocate them to entomologists well qualified for the extra tasks. It is hoped delay and confusion in disseminating useful information has been avoided to a substantial degree.

It was planned that at the annual meeting periods would be set aside during which the men involved in the special problems considered by the Committee might have opportunity to get together for informal conference, and for the making of plans of attack for 1943. Time had been designated for the leaders of various problems to discuss the work under way. Inability to hold the annual meeting made these plans impossible to carry out, hence leaders of various projects will find it necessary to continue their work by correspondence. The methods of attack must differ, and in many cases the cooperation of the extension service or of some other organization would be helpful. Sometimes special publications, posters or some other material might be demanded, and sometimes personal contacts are more vital than printed directions. The Committee reached the limit of its powers, abilities and ambitions when it selected a strong leader and asked him to undertake the job.

The Committee has published a list of special projects and the names of the men who seemed abundantly qualified to undertake the tasks. All of us hope that as a result of these requests for cooperation, an even more united attack may be made on our insect enemies at a time when insect pests must be considered as allies of the totalitarian powers. We have faith that those who have accepted these responsibilities will use their utmost efforts to carry to the actual users full available information on known control measures.

In discussing cooperative efforts among entomologists, it would be a gross oversight not to suggest briefly the extent to which such cooperation already exists. In its first report, the Committee indicated the existence of regional branch organizations and subject matter sections, in all of which men of allied entomological interest get together. Under the auspices of the Association of Economic Entomologists, men engaged in work on codling moth and other fruit insects of various areas, pea aphis, tobacco insects and the like, meet annually to exchange results, to stimulate each other by suggestions and criticisms and to

set about the heavy task of making their efforts more useful. It is doubtful if among men of any other branch of scientific work there is better cooperation than already exists among entomologists. The National and branch Plant Boards are added instances of cooperation of this type, extended in these cases to include plant pathologists and men officially responsible in quarantine activities. All this cooperation, set up in days of peace, gave the Committee a feeling of assurance that one may expect hearty cooperation from entomologists when an opportunity is presented or can be discovered. In seeking to increase this cooperative endeavor, the Committee feels that it is best following out a primary intent of the joint resolution.

The Committee considers it important to make known to entomologists that the National Research Council has formed a Committee on Crop Protection, composed of plant pathologists and entomologists, under the chairmanship of PROF. E. C. STAKMAN, who is also chairman of the War Committee of the Phytopathological Society. This committee, consisting of J. G. LEACH, J. L. HORSFALL, J. G. HORSFALL, W. P. FLINT and E. F. PHILLIPS, met in Washington on October 15. This National Research Council committee presents a favorable means for developing even more cooperation between entomologists and plant pathologists. It seems appropriate also to state that the Phytopathological Society is well organized in the war effort.

The Committee recognizes that the curtailment of activities of the Insect Pest Survey issued by the Bureau of Entomology and Plant Quarantine has been a vital loss to services which entomology can render in the battle against insect enemies, and in the present emergency this loss is felt in exceptional degree. Since delay would make any appeal inconsequential, the Committee on October 17, 1942, addressed a letter to the Director of the Budget urging the re-establishment of the Survey in full. The Committee feels that this action will meet with universal approval of entomologists.

The Committee was specifically asked to consider a problem, important not only to entomology, but equally to other lines of work, the authorized reorganization of research in the Department of Agriculture. On December 13, 1941, the Secretary of Agriculture issued Memorandum No. 960 entitled "Organization of Department for War Effort." This memorandum begins as follows:

> "In order to increase to the fullest possible extent the contribution of the Department of Agriculture toward winning the war, I am reorganizing the Department's administrative machinery.
>
> "The seventeen line agencies that now report directly to the Secretary are being grouped for more effective action and coordination under the direction of eight group administrators.
>
> "I am establishing an Agricultural Defense Board composed of eleven Department officials.
>
> "Through this Board and the grouping of the line agencies, we hope to contribute our maximum effort to the primary responsibility of American agriculture during the emergency—the production of the food and fiber needed by this country and her allies.
>
> "To this task, all others must be subordinated.
>
> "I feel that the reorganization will enable the Offices of the Secretary, the Under Secretary, and the Assistant Secretary to concentrate upon the production program and other vital wartime programs. I feel also that the changes will enable the Department to centralize responsibility for the execution of these programs; to center research activities of the Department upon war needs; to produce abundantly without soil waste and destruction; to move toward a reduction in the number of Department agencies in the field which farmers must contact; and to enable the Department to meet all increased duties and responsibilities with greater efficiency and economy."

The grouping of the 17 line agencies referred to in the foregoing quotation as it was carried out with respect to the Bureau of Entomology and Plant Quarantine is covered in a later paragraph which we quote:

> "During the first World War, the scientific research agencies of the Department made notable contributions to victory. We hope to see to it that these agencies are even more effective during this war. Therefore,

I am grouping together the Bureau of Animal Industry, Bureau of Dairy Industry, Bureau of Plant Industry, Bureau of Agricultural Chemistry and Engineering, the Bureau of Entomology and Plant Quarantine, the Bureau of Home Economics, the Office of Experiment Stations, and the Beltsville Research Center. These agencies will also retain their Bureau status, but their activities will be under the supervision and direction of an Administrator acting as my personal representative."

Secretary Memorandum No. 960 states with respect to the group administrators that:

"In the exercise of the authority vested in him by paragraph 1 of this memorandum, and in accordance with the applicable laws and regulations, the Administrator, or the Acting Administrator, shall, among other things, with respect to the agencies placed under his direction,

a. direct and supervise their activities;
b. direct and supervise the work of their officers and employees;
c. delegate, in his discretion, his authority to their officers and employees;
d. utilize their personnel, funds, property, and services; and
e. consolidate or integrate their administrative, technical, staff, and other services."

Later, under date of February 24, 1942, Executive Order No. 9069 consolidated certain agencies within the Department of Agriculture, the grouping being along the lines indicated in Secretary's Memorandum No. 960. This was followed on February 25 by Secretary's Memorandum No. 986 entitled "Establishing Agencies of the Agricultural Research Administration." The Executive Order and Secretary's memoranda outline the authority of the Agricultural Research Administrator. Broad powers are granted to make such changes in organization as may be deemed necessary. Since the authority thus granted might permit reorganization of existing groups on a crop basis or on any other basis, desired by the Administrator, concern was felt for the future of entomology. The authority granted in the Executive Order remains "in force during the continuance of the present war and for six months after termination thereof," but there is no time limit or period of duration fixed in the memoranda issued by the Secretary of Agriculture to indicate a date of termination for the exercise of this authority.

A reason for concern arises from the fact that on previous occasions the integrity of the entomological work of the Federal government has been threatened. In the late nineties a plan was proposed to reorganize all the work of the Department on a crop basis, but this plan was averted. Many entomologists will recall that in 1933 a committee of administrators within the Department was reportedly prepared to recommend organization on a crop basis. Before this plan was put into effect, a joint committee of the two entomological organizations made presentations to the Secretary of Agriculture which averted such action for entomology, but at that time certain other lines of scientific work were organized on a crop basis. These two instances in which efforts have been made to organize work on some basis other than that of the branch of scientific work involved, naturally cause entomologists to be concerned whenever changes in administration of scientific work in the Department of Agriculture are proposed or authorized. It then seemed important that inquiries be made. This was even more important because of other administrative changes already made in the organization of the Department.

On June 10, three members of the Committee interviewed the Secretary of Agriculture on this subject. They were assured that he had no knowledge of a plan to organize on a crop basis. Members of the Committee have been informed that the Administrator has stated that he has no intent of disrupting the existing bureaus or other organizations composing the Agricultural Research Administration. The Committee thinks it appropriate to express its gratification of this assurance of the continued status of the Bureau of Entomology and Plant Quarantine.

In view of the sweeping changes which have been made in the agencies of the Department by other group Administrators, the Committee believes that so long as this authority remains unchanged, watchfulness on the part of entomologists is essential to avoid later interpretations of this memorandum. We should be

on the alert for indications along the line of gradual encroachments in the administration of the Bureau and drastic reorganization plans or for the superimposing of administrative direction, which might not promote the best interests of entomological work.

Concern among entomologists at administrative changes actually rests on the eminence of the entomological work of the Department, which to entomologists is a matter of pardonable pride. The Bureau is the entomological capital of the world. In no country other than the United States has it been more imperative that effective control measures be found for insect pests. Importation of crop plants, development of specialized agriculture, changes of hosts of native species of insects and other changes in agriculture, especially since the Civil War, have made possible concentrations of insect populations, which unless curbed, would have dedicated far too much of our crops to the feeding of insects. The destruction caused by insects constitutes truly an enormous burden on citizens of the country. At a time when maximum crops are so important, losses from insects become still more vital, and entomologists know that even with the best control measures, losses remain too high. It has thus been necessary that under the federal government there be maintained a great fighting force to protect our economy from insect enemies. It is no surprise that federal work in entomology has risen to the top.

The war against the insects requires coordinated effort, and cooperative work has been developed between federal and state organizations, for widespread education as to the damage done by insects, in methods for their control, for unity of action, and more recently for the application of methods of adult education and for programs of eradication, all of which have made results of research more effective. The need of manpower has led to the growth of departments of entomology in various educational institutions often larger than departments in the broader field of zoology. Throughout this development, the Bureau retains a place of pre-eminence in almost every field except the training of entomologists which is outside its competence.

Inevitably in such a growth there have been occasions when differences of opinion have arisen between federal and state men, and sometimes questions of legal authority. Full harmony in so quickly developing a field would be evidence only of laxity. There is no reason for glossing over such situations, because, despite all occasions when policies of the Bureau have been questioned, all entomologists realize that from its strength, its strategic position and its manpower, the Bureau must be accorded first place in all the world in the battle against insects. Entomologists grant to the Bureau this place, and desire to have that place retained.

Not only has the Bureau provided leadership within the country, but its influence is world-wide. Entomologists of the Dominion of Canada have cooperated freely and have carried their full share of the load, in research and in methods of application. With Mexico and other lands of Ibero-America, partly because of our national policy of being good neighbors, but primarily independent of all political consideration, the Bureau cooperates to the benefit of all countries concerned. Only the work of the federal government could thus make itself felt all over the world. In a time of global war, much international cooperation is hampered, but if unmolested, the Bureau will later be prepared to renew its happy relationships with entomologists of the world. Probably no other American group in applied science has done more for international harmony than has the Bureau as the national representative of applied entomology. If the entomological work of the government had been organized on any basis other than that of the branch of science concerned, or if it had been merely a small unit in a huge over-all scientific administration, this committee believes such international cooperation could not have been developed.

The Committee then advises that the effort undertaken by action of the President of the American Association of Economic Entomologists be considered as a preliminary step, that plans for future efforts be considered with great care, and that provision be made whereby cooperative efforts may be increased and so planned as to prepare the profession of entomology for its far heavier tasks of the near future. Tasks ahead are heavier than any so far faced, and unless entomology justifies its existence through enlightened initiation of services, it will utterly have failed in its great opportunity. In this entomology will not fail.

Scores of entomologists have discontinued their accustomed work to meet the obligations arising from the war, and many more will be called upon either to drop their usual work or to take on added duties. Probably most of us for months and years to come will find that the work which we prefer, and even the work for which we are best equipped, is not that which yields the best results in the war effort, and whatever changes in duties may be indicated will be accepted gladly. Not only must we accept new obligations when they are pointed out to us, but we must seek through combined strength to anticipate opportunities, to discover other ways to serve and to prepare ourselves and others for opportunities not yet made clear. The appointment of a committee as a sort of clearing house for such work should in no degree be considered a solution of the problem of adjusting entomology to the needs of the time. In searching for opportunities by which entomologists may be of service, we shall remember that entomology cannot be helpful until its usefulness is evident to persons other than entomologists. All these things we shall do in a determination that one day we shall regain the freedom to do those things in entomology which most appeal to us, freedom to plan our own lives and freedom to serve in ways which we consider best, which are only other ways of stating the freedoms for which all free men now fight. Nothing now is so important as the winning of the war, and to that high cause entomologists dedicate themselves.

Respectfully submitted,

ERNEST N. CORY, S. A. GRAHAM,
JOHN S. HOUSER, AVERY S. HOYT,
L. M. PEAIRS, P. D. SANDERS,
FRANK N. WALLACE, E. F. PHILLIPS, *Chairman*.

REPORT OF THE JOINT COMMITTEE ON MILITARY ENTOMOLOGY

PRESIDENT WEISS, of the American Association of Economic Entomologists, and PRESIDENT ALEXANDER, of the Entomological Society of America, appointed a committee consisting of DR. C. H. RICHARDSON and DR. F. L. CAMPBELL to collaborate with DR. P. N. ANNAND in initiating steps toward carrying out the intent of the following joint resolution adopted at the San Francisco meeting of these two entomological societies:

"WHEREAS, during this National Emergency the profession of Entomology is conscious of the need for leadership and organization of effort, and

"WHEREAS, the Bureau of Entomology and Plant Quarantine is in a unique position to furnish this leadership, and

"WHEREAS, time is a vital element in the development of a national program,

"*Therefore, be it Resolved*, that the Chief of the Bureau of Entomology and Plant Quarantine be requested to call together at the earliest practicable moment a group of entomologists representative of the various entomological organizations, institutions, and geographic areas of the United States for the purpose of ascertaining the best possible use of entomological personnel and facilities and for the development of a program for the most effective utilization of these resources, and that a copy of this resolution be sent to the Secretary of Agriculture and the Chief of the Bureau of Entomology and Plant Quarantine."

The committee met and made its report to the Presidents of the two Associations on April 6, 1942. The committee report made reference to its interpretation of the resolution and the field of its discussions as follows:

"The stated purpose of the resolution calls for a program for the most effective utilization during the war of both entomological personnel and facilities and therefore might be interpreted to include both military and civilian activities of entomologists. However, those who were present at the meeting of the Teaching Section in San Francisco where the resolution originated were of the opinion that its primary purpose was to facilitate the utilization of entomological personnel in the military services. Your committee therefore felt that it would be best to confine their discussions and recommendations to the military problem, as it seemed impossible to cover effectively a broader and unlimited field of civilian service."

It reviewed the possible relations of entomologists to the military, and nominated a committee to act for the two Associations—outlining its views as to the functions of this latter committee and suggesting that it be called "Committee on Military Entomology." It also proposed a questionnaire designed for use in assembling information on entomologists to aid the Army and Navy in securing properly trained personnel for entomological work and to provide data on entomologists for any specialized service that might arise in connection with the war.

Upon its appointment, the Committee on Military Entomology began to function at once by further developing contacts previously made with responsible officers in the Medical Departments of the Army and Navy where entomologists were urgently needed. Steps were also taken to prepare, print and distribute to the membership of the A. A. E. E. and E. S. A., through the secretaries of these societies, a questionnaire which was first presented to the military for comment. The distribution of the questionnaire was not restricted to the membership, however, since the committee's aim is to be of the greatest possible service to entomologists as a whole and especially to the military services.

Questionnaires, totaling 1,025, have been completed and returned. These have been classified according to expressed interest in entering the military service, and training and experience. They have been carded and records are maintained as far as practicable on those entomologists who have entered the military service.

The Committee on Military Entomology has maintained close contact with the personnel officers of the Army and Navy, and has supplied them, when requested to do so, with lists of entomologists available for service. The complete information as it appears on the questionnaire, together with information regarding these men as supplied in letters of recommendation, has furnished the basis for most appointments.

The Army has commissioned more than 100 men in the Sanitary Corps for entomological work. Some additional men will soon be commissioned and it is probable that this number will be added to materially during the year.

A few of the entomologists in the Army were reserve officers who were called to active duty and transferred to the Sanitary Corps, but most of them were commissioned as First Lieutenants. Four entomologists now rank as Lieutenant Colonels, 8 as Majors, and 14 as Captains.

The Hospital Corps Volunteer Service (H-V-(S)) of the Navy has commissioned a considerable number (figure cannot be divulged) of entomologists and some additional ones may be appointed during the year.

The entomologists entering the Navy were commissioned as Ensigns and Junior and Senior Lieutenants.

The Committee has been able to lend some assistance to the U. S. Public Health Service in finding entomological personnel for mosquito and other insect control work in extracantonment areas.

Consideration was given to the possibility of more fully utilizing the training and experience of entomologists volunteering or being inducted into the service, by having them detailed to entomological or other biological work. Accordingly arrangements were made to have entomologists included in the enrollment of medical technologists by the American Red Cross. Through this plan a number of entomologists have been assigned to the Medical Department where they will be available for detail to entomological work.

The opportunities for entomologists to perform useful service in branches of the Army other than the Medical Department have also been explored, and the attention of the Corps of Engineers and Quartermaster Corps has been directed to the ways in which entomologists might be advantageously used in those branches of the service. These Corps have made some use of entomologists of the Sanitary Corps and there is reason to believe that some men may be commissioned for full-time service in them.

The type of training best fitting men for entomological work in the armed forces has been considered and advice on curricula has been supplied to a number of universities. Naturally, under present conditions many difficulties are encountered in training entomologists but these are probably no greater than those confronted in other fields. The lack of training in medical entomology has been

forcefully brought out in connection with our efforts to assist the military in finding men ready to handle work in this field. Although men well trained in agricultural entomology have given satisfactory service with the armed forces, there is no doubt that their initial effectiveness would have been enhanced if all had received training in medical entomology as an essential part of their curriculum.

A rather extensive correspondence has resulted from inquiries as to opportunities and needs for entomologists in the military service. In this and in personal contacts of the committeemen an effort has been made to help entomologists evaluate their opportunities for service to our Nation, whether in the armed forces or in their present capacity as civilian entomologists.

Although the drain of the military demands for entomologists has been severely felt in some quarters, thus far it is thought that the needs have been reasonably well met and the number of entomologists has been sufficient to fill available positions.

The provision of special training courses for commissioned entomologists has been discussed with Army and Navy officials, but in general they have felt that provision of formal courses in medical entomology and supporting subjects is difficult to arrange and the needs of the service can be met by less formal training as now provided by the Army and Navy.

Return of troops infected with malaria, filaria, or other insect-borne diseases presents a menace to the civilian population. This should be provided for by starting now to develop post-war plans for the full utilization of trained sanitary entomologists and others (such as engineers, mappers, supervisors of labor, and developers of machinery for antimosquito work) mustered out of the service. This would absorb trained and experienced personnel, and help to protect the health of our people, thereby maintaining the productive capacity of the civilian population.

Efforts to impress military leaders of the importance of the maintenance in the military services, after the war, of an adequate number of entomologists should be considered a function of this committee. The protection of personnel, supplies, and installations from insect menace is a necessary continuing function of the armed forces that can be handled best by those now gaining experience under war conditions. Such men will be able to furnish the leadership quickly and effectively to implement entomological work in any subsequent emergency.

In order that the Committee may be of maximum service to military authorities and entomologists, it is essential that a record of the military allocation of every entomologist be available to the Committee. More than 500 such records are now available through the list that has been compiled in the office of SECRETARY CORY. Completion of this list is urgent and the Committee requests that those who have not sent in to SECRETARY CORY a record of their present military service do so at once. Those who have not sent in the War Work Questionnaire should send this immediately to DR. F. C. BISHOPP.

Respectfully submitted,

E. N. CORY,
ROBERT MATHESON,
F. C. BISHOPP, *Chairman.*

The following exhibits were to have been on display at the New York meeting:

1. The Common Insects of Kansas. ROGER C. SMITH, Kansas State College, Manhattan, Kansas.
2. Nine species of Hymenopterous Parasites Collected from *Eurukuttarus confederata* Grote, Including Two Unidentified Species. JOSEPH L. WILLIAMS, Lincoln University, Pennsylvania.
3. Life History of the Flat Grain Beetle, *Laemophloeus minutus* Olivier. NELLIE M. PAYNE, American Cyanamide Co., Stamford, Connecticut.
4. The Mosquitoes of the Great Swamp in Rhode Island. HERBERT KNUTSON, Rhode Island State College, Kingston, Rhode Island.

Respectfully submitted,

CLARENCE E. MICKEL, *Secretary.*

NOTICE TO MEMBERS AND CONTRIBUTORS

The Annals of the Entomological Society of America, published by the Society quarterly, includes the Proceedings of the Annual Meetings and such papers as may be selected by the Editorial Board.

Papers may be submitted to any member of the Editorial Board and should be as nearly as possible in the form desired as final, typewritten, and illustrations finished complete ready for reproduction. Plates must not exceed 4¼x6¾ inches unless intended to fold. Cuts for illustrations are charged at cost to the author. In general, papers to be accepted must be original, complete and previously unpublished. Authors will be allowed fifty reprints gratis and additional copies at cost to the Society.

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